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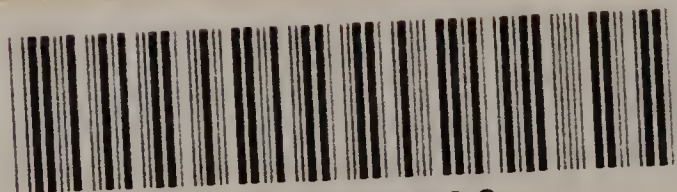
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# THE CHEMICAL NEWS.

VOLUME XXI.

EDITED BY WILLIAM CROOKES, F.R.S., &c.

No. 528.—FRIDAY, JANUARY 7, 1870.

## NOTES FROM THE LABORATORY OF A SUGAR REFINERY.

By WILLIAM ARNOT, F.C.S.

### I. DR. SCHIEBLER'S CALCIMETER.

THE almost daily use, for some years, of Dr. Schiebler's expeditious instrument for the estimation of carbonic acid in carbonates, and the invariably consistent results obtained, have made it quite a favourite with the author of these notes. Believing the instrument to be far too little known, he would seek to call attention to its value, especially to those who have the charge of sugar refineries, where the frequent estimation of calcic carbonate in animal charcoal is a desideratum.

With a little practice, twelve or fourteen estimations may easily be made in an hour; and these, if upon the same finely-powdered sample, will, with ordinary care, be found to agree almost absolutely. The saving of time by this process over the most expeditious of the ordinary gravimetric methods (which alone are applicable to substances like bone-char) will be found to be very great. Starting, in each case, with the sample in powder, the difference in time is such as easily to repay the first cost of the instrument by a few hours work. As the instrument is sold with a normal weight and tables of calculated results, no time is lost in after calculations. The volume of carbonic acid, and the temperature indicated by the instrument, are referred to the tables, where the percentage quantity of carbonic acid or calcic carbonate is at once found. One great advantage of such an expeditious method as this is that there is no temptation to be satisfied with first results, as a few minutes suffice to repeat the process. A general description of the instrument and process, in English, will be found in the last edition of "Fresenius" (Quantitative Part); but a perusal of the original German instructions will be found profitable.

In most freshly-burnt bone-chars, traces of sulphides are to be found. These, of course, vitiate the results obtained by Dr. Schiebler's instrument to a trifling extent; but the author has not found, over a wide experience (unless on one occasion), more than 0.5 per cent of the evolved gases to be hydric sulphide; so that, for all practical purposes, that may be entirely overlooked.

### II. THE ACTION OF FINELY-DIVIDED CARBON ON SOLUTIONS OF THE CHROMATES IN HYDROCHLORIC ACID.

On the occasion of finding excess of sulphides in a sample of bone-char, referred to above, an effort was made to oxidise the sulphur simultaneously with the evolution of the carbonic acid in the decomposing jar, but only with indifferent success. In the course of the experiments, undertaken with that end in view, a solution of potassic bichromate in strong hydrochloric acid was

used. On decanting this solution from the little gutta-percha tube, upon the powdered charcoal in the decomposing jar, *instant* and *rapid* disengagement of chlorine resulted. It is well known that chlorine is *slowly* evolved from the solution referred to in the cold, *more rapidly* when heat is applied, and *still more rapidly* on the addition of alcohol and some other organic substances.\* Animal charcoal, or bone-black, which produced the *instantaneous* effect referred to, is a very complex agent. Its peculiar action as a decolouriser is well known. It was, therefore, a question whether this was an action analogous to decolouration, or if it was due to the action of some individual substance present in the char. The various constituents were tried, one by one, in every case, without producing the result, unless with the carbon, which, when as pure as attainable, produced the very same result as the original powdered char. The char, minus the carbon only, had no effect. It was, therefore, clear that it was the carbon which had brought about the instantaneous decomposition. This carbon exists in a very fine state of division. Its action, in this case, must be analogous to that of platinum, in mysteriously determining the decomposition of certain substances, as the carbon itself is in no way acted upon. Further experiments were made, to determine whether this action was similarly promoted by other forms of carbon. Many varieties, from both vegetable and mineral sources, were tried; but in no case was the decomposition of the chromate solution promoted to any appreciable extent by their presence. Charred blood was also tried, and with more success, though the decomposition was by no means so rapid as in the case of the bone-char.

### III. PREJUDICIAL ACTION OF SULPHITES AND SULPHATES IN THE REFINING PROCESS.

BESIDES the impurities natural to unrefined cane sugars, and which vary in quantity, and to some extent in quality also, according to the care bestowed in the manufacture and other local circumstances, there are not unfrequently present one or more injurious agents which have been introduced, not as adulterants, but to counteract some adverse natural circumstance or action. Among these agents bisulphite of calcium occupies a prominent position. In several cane-growing countries, the natives, or colonists, are dependent, in great measure, upon wind power for the performance of certain mechanical operations; pressing the juice from the cane is one of these. The canes being ripe and the wind fair, the planter proceeds to cut down his crop; but, before this is well accomplished, the wind falls; what is to be done? To allow the cut canes to lie in their natural condition until a favourable breeze springs up, may be to submit to a very serious loss of crystallisable sugar by fermentation. To counteract this destructive process, bisulphite of calcium, mixed with water to the consistency of ordinary milk of lime, is sprinkled over the canes from time to

\* Gmelin, Cav. Stoc. Trans., vol. iv., p. 120.



time, until the elements supply the necessary motive power to allow the pressing to proceed. As the pressing goes on, the lime salt mingles with the juice, and is never afterwards entirely removed from the manufactured sugar. Much of the raw sugar which arrives in this country, to undergo the process of refining, thus contains notable quantities of sulphites and sulphates; these range in quantity from the merest trace to amounts which might seem to some incredible. In these circumstances it becomes important to ascertain the action of these salts in the refining process, and their consequent effect upon the value of sugars containing them. In the first place, they, of course, in common with all other impurities, reduce the percentage quantity of saccharine matter in the sample; and as it often enough occurs that the *best looking* samples contain the impurities referred to in greatest quantity, it is always advisable to estimate the total impurities previous to purchase. The sugars being blown-up and mechanically filtered, are next submitted to the purifying and decolourising action of animal charcoal; in this process a large proportion of the sulphites and sulphates are removed and retained within the pores of the char. The washing, to which the char is afterwards subjected, removes a portion of these salts along with other impurities, but they are never entirely washed out. The re-burning succeeds the washing, and in this process the sulphates, or a portion of them, depending upon the temperature at which the re-burning is conducted and other minor circumstances, are decomposed at the expense of the carbon—carbonic anhydride being evolved and calcium sulphide formed. The char being re-burned and cooled is ready for its work of decolouration again; the sugar liquors—acid almost to a certainty—are run upon it, and as they pass through, decompose the calcium sulphide, with formation of hydric sulphide, which the liquors absorb. There are thus two prejudicial effects produced: first, the removal of a portion of the most valuable agent in the char—the carbon—and next the formation of an agent in the sugar solution, which is most potent in promoting fermentation, and consequent destruction of saccharine matter. The quantity of carbon removed and hydric sulphide produced by one complete circle of the refining process is comparatively trifling, but when it is remembered that the same char is often re-burned and used twice a week, the ultimate extent of the injury can be imagined. From extended personal observation, the author of these notes is satisfied that from 10 to 20 per cent of the decolourative power of animal charcoal may be destroyed in the course of twelve months by a continued use of sugars containing the agents referred to.

A little consideration will show, what numerous experiments have proved, that char *ready for re-burning* seldom or never contains sulphides, while re-burned char always contains more or less; *traces* of sulphur compounds being, as a rule, present in all unrefined sugars.

Long experience and numerous experiments have enabled the author to decide upon deductions to be made, from the marketable value of sugars, in proportion to the quantity of sulphates, &c., they contain. The mode of testing is exceedingly simple, but as the conclusions come to are quite arbitrary, so far as monetary figures are concerned, he would not advise the unexperienced to proceed upon his system, but would suggest to those interested in the problem a careful experimental investigation of the whole subject.

#### IV. THE CHEMICAL IMPURITIES OF "LOW" BEET SUGARS.

As a rule, the finest products of the beet are manufactured directly into loaves in the various beet growing countries; the second, or perhaps more frequently, the third crop of crystals being exported.

British refiners are thus called upon to deal with sugars containing large proportions of chemical impurities, some of them very injurious to the sugar itself, while others act most prejudicially on the charcoal used in the refin-

ing process. Amongst these agents, sulphates usually hold a prominent place; it is needless to say that their action is just as injurious in the product of the beet as in that of the cane. Alkaline chlorides also abound, and their action is at least as injurious as that of the sulphates. Any one who has had the opportunity of observing beet sugar liquor, and cane sugar liquor, of the same original colour, passed through separate cisterns of the same charcoal, must have been struck with the very great difference in the effect produced: the cane liquor bright and colourless, the beet *possibly* bright, but decidedly yellow; and this difference is rather increased than lessened by the after process of boiling. The share which the alkaline salts have in reducing the colour value of the refined product is unquestionable, and their injurious action does not end there; they tend throughout the whole refining process to destroy crystallisable sugar, while their action on the charcoal, unless when very copious washing is practised, is very objectionable. The salts referred to, being fusible, the risk of coating the char in the re-burning process is considerable. Several otherwise good chars, which have been sadly injured in this way, have come under the author's observation. The practical point to be observed is this, that whereas even the very lowest "beets" commend themselves to the eye, in virtue of the size, strength, and abundance of the grains or crystals, they are often so charged with potent impurities, as to be entirely inadmissible as subjects for the British refiner to operate upon. The evil effects of the repeated use of such low class beets, soon manifest themselves over the whole refining establishment—not least on the sale-room counter.

The foregoing has, of course, little or no reference to the beautiful first products of the beet, occasionally imported, though even these are tainted, to a greater or less extent, with some of the characteristics of the low beets.

In the circumstances here noted, it must be manifest to every refiner, that to purchase beet sugars, or indeed any sugar, as will be evident from a perusal of the preceding (III.) note, by the rule-of-thumb system, so generally prevalent, is, to say the least of it, very risky.

Nothing but rigorous chemical examination can point out the true commercial value of unrefined sugars. The eye can detect many useful indications of quality, but these ought always to be supplemented by an investigation of the qualities which do not appear on the surface, and which chemical analysis alone can reveal.

Dubrunfaut, who, along with other continental chemists, has made the action of the impurities of beet upon the crystallisable sugar a special study, has fixed upon a coefficient by which to arrive at the quantity of *extractable* sugar contained in any sample submitted to analysis. The removal of these objectionable salts has also engaged the attention of several eminent continental chemists, and from the results obtained, it is manifest that other methods of dealing with beet sugars must be adopted from that followed in the refining of the produce of the cane. We, in Britain, seem to have fallen asleep upon this subject. The process of sugar refining is eminently a chemical one, and at every stage there is room for investigation and improvement.

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### THE MODE OF TESTING MINERAL OILS USED FOR LAMPS.

By BENJAMIN H. PAUL., Ph.D.

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THE degree of inflammability of the mineral oil now used for lamps is a character which the chemist is sometimes called upon to determine; and since recent enquiries appear to indicate that there is considerable difference of opinion as to the mode in which mineral oil should be tested for the purpose of determining that character, I have thought that this subject, though not one of any scientific interest, would be worth bringing under the notice of the



readers of the CHEMICAL NEWS, especially since the degree of inflammability of mineral oil is now attracting considerable attention in reference to the question of danger attending the use of such oil in lamps.

All kinds of mineral oil, whether derived from coal, or bituminous shale, or from petroleum, are, by their nature, more inflammable than the fat oils, such as sperm oil and colza oil, formerly used for lamps, that is to say, they take fire more readily and at a lower temperature than the latter; they also differ from those oils in being partially volatile at a temperature which has no similar effect upon the fat oils. Since the vapour thus given off is inflammable, and, when mixed with air in due proportion, capable of exploding, it is evident that the use of any kind of hydrocarbon oil requires, for both the reasons just mentioned, a greater degree of care than is necessary in the use of fat oils.

In considering the question of danger to be apprehended from the use of mineral oil in lamps, the conditions under which it is used in a general way must be taken into account; and so far as the inflammability of the oil is concerned, the point to ascertain is not merely what oil may be used without any necessary danger, but what kind of oil will answer the purpose for which it is required as an illuminating material without, at the same time, requiring any greater degree of caution in its use than can fairly be expected under the circumstances. Even the more volatile portions of petroleum and paraffin oil, constituting what is generally termed "spirit," or naphtha, benzoline, ligroine, &c., may be burnt without any necessary danger in some of the ordinary paraffin lamps, which are constructed in such a manner that there is no free communication between the flame and the oil reservoir. But this material, which begins to boil below  $100^{\circ}$  F., and distils over completely below  $300^{\circ}$  F., while it is readily volatilised at the ordinary atmospheric temperature by contact with air, is much too volatile for general use in that way, except in the special form of lamp known as the "sponge lamp;" and, for that reason, it can scarcely be regarded as a suitable material for burning in what is termed the paraffin-oil lamp. The fact that it can be used in this way serves merely to show that any danger attending the use of mineral oil in lamps is less referable to its volatility and greater inflammability, as compared with fat oils, than it is to carelessness, or misuse, and the neglect of those precautions which the nature of this material renders indispensable. But, though the possibility of improper usage cannot reasonably be regarded as justifying any considerable restrictions in the application of a material so useful as mineral oil, still some allowance requires to be made for it; and since, in this respect, the degree of inflammability is the character of the greatest importance, it is customary, in the operation of refining, to separate and exclude from the oil to be used for ordinary lamps, a certain amount of the more volatile hydrocarbons contained in the crude petroleum or paraffin oil. The extent to which this is done is not in all cases the same, and there is some difference of opinion as to what should be the minimum degree of inflammability of the oil, or the minimum temperature at which it should be capable of giving off inflammable vapour, in order to ensure for it such a degree of safety as would be consistent with the general circumstances under which it is used in lamps and kept as a commodity in shops. By some, it is considered that when a flame is brought into actual contact with the oil, heated in an open capsule, it ought not to take fire, so as to continue burning, until the temperature reaches  $130^{\circ}$  F. Others, again, consider that, if it does not take fire at a temperature below  $100^{\circ}$  F., it is of a character fit to meet all requirements.

Hitherto, far less attention has been paid to the degree of inflammability of mineral oil than to the absence of smell and colour. It has also been customary in different countries to use oil differing widely in regard to the temperature, at which it would take fire. Some years ago, the oil generally consumed in this country had a very high firing

point, and it was customary to test it by observing how long it would bear contact with the flame of a match without taking fire, or more accurately by observing the temperature at which it took fire and continued to burn. This temperature was generally from  $120^{\circ}$  to  $130^{\circ}$  F., and sometimes it was as high at  $150^{\circ}$  F. The oils manufactured about eight years ago, from Rangoon petroleum, and from coal or bituminous shale, were of this kind. On the Continent, oil inflammable at a much lower temperature has generally been preferred.

After the introduction of American petroleum, there was a marked difference in the character of the imported lamp oil manufactured from this material, so far as regards the degree of inflammability, and it would often take fire at a temperature little above  $100^{\circ}$  F. During the last three years, the firing-point of this oil has been still further reduced, and probably the greater part of the lamp oil imported from America and made from petroleum, which has been consumed during that period has had a firing point below  $100^{\circ}$  F., sometimes considerably lower.

In addition to the differences, both of opinion and practice, in regard to the degree of inflammability of mineral lamp oil, there are also similar differences as to the mode of determining this character, and as to what is to be regarded as the firing point.

This oil being in all cases a mixture of several hydrocarbons belonging to the paraffin series chiefly, and varying in their boiling points from about  $200^{\circ}$  to upwards of  $700^{\circ}$  F., the temperature at which it begins to give off vapour will depend upon the boiling points of the more volatile hydrocarbons, and upon the amount of them contained in the oil. Consequently, when the oil is gradually heated in contact with air, and a flame is brought near the surface from time to time, there is always a little momentary flash, produced by the vapour taking fire; and this happens some time before the oil attains the temperature at which it takes fire itself, and continues to burn. The difference between the temperature at which the temporary flash takes place, and that at which the oil takes fire, will amount to from 10 to 20 degrees Fahrenheit.

Upon the assumption that an explosive mixture of oil vapour and air may be formed within the reservoir of a lamp, it has been urged that the temperature of the oil when this temporary flash takes place should be considered as the firing point of the oil.

The quantity of vapour given off by mineral oil at the temperature when the first temporary flash takes place, is generally very small, even when the oil itself takes fire at  $100^{\circ}$  F.; and as the oil in the glass reservoir of a paraffin lamp, while it is burning, seldom acquires a temperature more than about ten degrees above that of the surrounding atmosphere, there would not be much probability of any such quantity of vapour being produced within the reservoir as could give rise to explosion by contact with flame. In regard to this point, however, the construction of the lamp is of considerable importance. In some lamps the pin by which the height of the wick is adjusted is so arranged that there is free communication between the flame of the lamp and the oil reservoir, and between the two there is a small metal chamber, with a hole at the side, through which the pin passes. This chamber, in common with the other brass fitting of the lamp, being heated to a temperature much above  $100^{\circ}$  F., will of course become filled with vapour given off from the oil as it passes up through the wick; and that vapour, by mixing with air, may form an explosive mixture in the immediate neighbourhood of the flame. In other lamps the pin is fitted in such a way that there cannot be any accumulation of oil vapour near the flame, and there is not any communication between the flame and the reservoir, except through the tube in which the wick is placed. The latter form of lamp is in this respect much preferable to the other, and it is the only kind of lamp in which a very volatile oil can be burnt. But the fact of most importance in regard to the determination of the inflammability of mineral by the "flashing point" is that the result



obtained with a given sample of oil in this way, may vary several degrees, according to the mode in which the test is applied. If the surface of the oil is freely exposed to the air, in an open vessel, such as a shallow capsule, the firing point of the vapour may be found to be some degrees higher than when the test is applied in a small wide-mouthed bottle, or in the reservoir of a paraffin lamp, half-filled with the oil.

The difference before referred to between the temperature at which, in testing oil to ascertain the firing point, the temporary flash takes place, and that at which the oil itself takes fire and continues to burn, also depends very much upon the mode in which the experiment is made. With a shallow, open basin, the difference is much less than it is when a wide-mouthed bottle or a small lamp-reservoir is used. The more freely the surface of the oil is exposed to the atmosphere, the lower will be the temperature at which it takes fire; while, on the contrary, the less freely it is exposed, the lower will be the temperature at which the vapour given off takes fire. Consequently, in fixing a point of temperature as the minimum at which either the oil itself or the vapour it gives off, should take fire by contact with flame, it is necessary that the conditions under which the experiment is to be made should be precisely defined, and that the testing of oils should always be conducted in the same manner, so as to obtain uniform and corresponding results. It is, of course, desirable, also, that these conditions should assimilate as much as possible to those obtaining in a paraffin-oil lamp when it is burning, since any danger that might arise from the inflammability of the oil would exist chiefly in the ordinary use of this material in lamps.

It is singular, however, that the Act passed in 1868, to amend the Petroleum Act of 1862, prescribes a mode of testing mineral oil under conditions that are the direct opposite of those prevailing in the use of the oil. While a mineral oil lamp is in use, the oil is heated in a closed vessel partly filled with air, which thus becomes charged with oil vapour, proportionately to the volatility of the oil, or part of it, and to the temperature the oil is raised to. Any oil vapour given off is confined; and, if the oil be sufficiently volatile or sufficiently heated, such formation of oil vapour may result in the production of an explosive mixture within the oil-reservoir of a lamp.

On the contrary, in testing mineral oil according to the directions given in the Schedule appended to the Act of 1868, the oil is heated in an open vessel, with the surface freely exposed to the atmosphere. Under these conditions, any oil vapour formed is liable to diffuse away into the surrounding air, and become thus so much diluted as to lose its inflammable character. Consequently, the temperature at which the momentary flash takes place with any given sample of oil when a flame is brought near its surface, will be, for that reason, higher than when the escape and dilution of the oil vapour is prevented—as in a paraffin lamp, or by making the test in a partially-closed vessel.

A still more serious interference with the results of the test would be experienced if the operation were conducted in a place exposed to draughts; and probably much of the discrepancy in the results of oil-tests has arisen in this way.

But there is yet another source of discrepancy in the results of tests made in accordance with the directions of the Petroleum Act, and one which is of far more importance, because no notice is taken of it in those directions, and, consequently, its influence may be greater or less according to accident or to the practice of the operator. This source of error lies in the rate at which the oil is heated, or the time occupied in making a test. All that the Act directs in this respect is that "a small flame shall be applied to the bottom of the outer vessel," which serves as a water-bath, and that this vessel "shall be filled with cold, or nearly cold, water." Both these directions are extremely vague. But, leaving out of consideration any difference that might arise from using

"cold" water at 40° F., or "nearly cold water" at 70° F., the rate of heating the oil from either temperature up to 100° F. has such an influence on the result obtained that there may be a difference of quite 5° in the flashing point of a given sample of oil, accordingly as the heating is made to occupy a longer or shorter time; and this will be the result, even though a "small flame" be used in both cases. Some experiments I have recently made show that there is a possibility of even greater variation in the result obtained as the "flashing point" of one and the same sample of oil.

Such a defect as this in the prescribed mode of testing mineral oil leaves the practice of this test entirely subject to the option or fancy of the operator; and it is alone sufficient to render the application of the test totally useless for the purpose of determining the character of mineral oil in regard to inflammability, and worse than useless for all the purposes of the Petroleum Act, besides rendering this Act and its application a possible source of serious inconvenience to those engaged in the mineral oil. On these grounds alone, therefore, there seems to be ample need for a revision of the law, and for the adoption of a more suitable test.

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## ON CHEMICAL EQUILIBRIUM.

INFLUENCE OF PRESSURE ON THE REACTION BETWEEN  
CARBON AND HYDROGEN.

By M. BERTHELOT.

THE play of conflicting chemical reactions, and the equilibrium established between them, are simplest, theoretically, when such reactions are developed in homogeneous systems, entirely gaseous, or even entirely liquid, and capable of remaining homogeneous during the whole duration of the experiment.

Under these conditions, all the reacting particles remain in complete and unceasing contact, no secondary complication occurring to withdraw one of them from the field of chemical action. Not so in the case of reactions which take place between a gas, or liquid, and a solid; under these circumstances, reaction occurs only at the points of contact, which undergo the influence of numerous physical conditions, accessory and foreign to true chemical action, which they tend to complicate.

Meanwhile, the principal masses, separated from each other by the gaseous state of the one, opposed to the solubility of the other, remain neutral and inactive.

The homogeneous system is, therefore, in my opinion, the best adapted for the theoretical study of affinities—that is, the study of those forces which determine chemical combinations and decompositions.

From this point, my researches commenced upon the study of affinities, examined in ethereal reactions, which present a type of slow progressive action and of action limited by inverse reaction.

Ethereal reactions may be examined by an entirely gaseous system, or by one wholly liquid and permanently homogeneous. Their characteristic equilibrium varies continually with the relative proportions of reacting bodies, contrary to what occurs in reactions of acids on bases. It also varies continually in gaseous systems, according to the pressure—that is, according to the condensation of matter, but it is independent of temperature between the limits of zero and 280°.

The fundamental condition of homogeneity is, perhaps, fulfilled by reactions effected on the gaseous system under lively combustion, such as were studied with such advantage by M. Bunsen. Here the reactions are abrupt, and occur almost instantaneously: the equilibrium which generally arises between contrary actions no longer obeys the laws of continuity, but varies after the manner of



chemical equivalents. When the proportions of reacting bodies change progressively—as, for instance, in systems formed of hydrogen, oxide of carbon, and oxygen, on the contrary, the relative proportions of products formed vary by abrupt leaps.

The relation between the entire volume of a mixture of combustible gas and that of the portion which will produce, at a given temperature, a new composition, also varies by abrupt jumps, when the temperature is gradually made to vary by introducing into the mixture an inert gas. There will then exist several intervals of temperature, more or less great, between which the limit of the reaction is independent of changes of temperature. To establish a complete parallel between ethereal reactions, and those of the gaseous systems, the influence of pressure upon the latter must be ascertained.

Between acetylene, hydrogen, and carbon reduced to vapour by the electric arc, or spark, such an equilibrium is established that a mixture of acetylene and hydrogen, made in suitable proportions, remains unaltered by the spark. If, on the contrary, acetylene predominates, it decomposes until the above-mentioned proportions are reproduced. These facts were established in a previous communication; since then, I have submitted a mixture of acetylene and hydrogen to the action of the spark under different pressures. This is my method of operation:—

The gases were contained in large eprouvettes, into which were passed gas tubes, bent round and traversed by thick platinum wire. The spark produced by a strong induction coil passed direct between the platinum wires, without breaking upon the glass or any other cold body capable of suddenly condensing the carbon vapour. The pressure was measured directly by the height of a column of mercury, and the mixture was analysed every hour, until the composition remained invariable during three consecutive tests. In the experiments made under very feeble pressure, it was necessary to repeatedly cleanse the eprouvettes containing the gaseous mixture, and, even then, to reject the first trials, because the formation of a small quantity of oxide of carbon proved the introduction of small quantities of air, or of moisture contained with the mercury. This oxide of carbon disappeared after the second or third trial, on care being taken to preserve from contact with the air the interior of the eprouvette and the tubes which conducted into it the platinum wire. The following results were obtained:—

Pressure. m.	Limit of Proportion of Acetylene in 100 volumes.			
3.46	..	..	..	11.9
0.76	..	..	..	12.0 to 12.5 (in several trials.)
0.42	..	..	..	11.9
0.41	..	..	..	12.0
0.31	..	..	..	6.5
0.23	..	..	..	3.5
0.18	..	..	..	3.1
0.10	..	..	..	3.1

The pressure was not reduced further, because the volume of gas under treatment would have been too small for correct analysis.

These numbers prove that the equilibrium between the carbon, hydrogen, and acetylene remained fixed at the same limit (12.0) for pressures which varied from 0.41 m. to 3.46 m., that is to say, as 1 is to 8½.

The increase of pressure has no effect but to augment extremely the resistance to the passage of the spark, and also its brilliancy. According to my experience, this increase of brilliancy does not correspond with any change in the composition of the gas traversed by the spark.

Even the rapidity of decomposition, which causes the disappearance of the excess of acetylene under treatment, does not appear to vary much with pressure, as far as it

was possible to judge under the circumstances. Below 0.41 m.—that is, at 0.31 m.—the limit is suddenly brought down to 6.5—viz., half the preceding one. At 0.23 m., the limit is suddenly reduced to the quarter of it, and remains the same, at least to 0.10 m.

Thus, while the pressure varies continually, the equilibrium between the acetylene, carbon, and hydrogen changes, by sudden leaps, in ratios which are multiples of each other.—*Comptes Rendus*, vol. lxxviii., p. 810.

## ON THE MICROSCOPICAL EXAMINATION OF MILK UNDER CERTAIN CONDITIONS.\*

By J. B. DANCER, F.R.A.S.

IN August and September last an account appeared in one of the newspapers (and also in other periodicals), which had been copied from the *Journal des Connaissances Médicales*, of some microscopical observations made by M. V. Essling on Milk, in which the author stated that “if the surface of fresh cream be examined under the lens, one perceives, amid myriads of milky and fatty globules, a number of either round or oblong corpuscles, sometimes accompanied with finely dotted matter, being neither more nor less than germinative masses of vibrios—just what is seen in most substances in a state of putrefaction. In summer these corpuscles make their appearance within 15 or 24 hours after milking; in winter they will be perceptible after the lapse of two or three days. If the observation be continued until the moment of coagulation, we see these corpuscles increase in number, bud, form ramified chains, and at length be transformed into regular mushrooms or filaments composed of cells placed end to end in simple series, and supporting at their extremities a spherical knob filled with granulous matter. M. V. Essling thinks that they may be classified among the Ascophora. But the important point is, that the first appearance of these spores occurs *before the milk gets sour*, and as this substance is almost the exclusive aliment of children, there is reason to suppose that many of the gastric affections to which they are subject are owing to this state of the milk. To prevent these evil consequences, M. V. Essling recommends the milk to be drunk as soon as possible after extraction, and, at all events, to keep it closely bottled during the interval, so as to keep out the smallest particle of air. Moreover, the temperature should be kept as nearly as possible the same as that which the milk had in the teats.”

Having for many years been familiar with the microscopical appearance presented by milk and cream, and not having seen the changes as described by M. V. Essling, I was desirous of satisfying myself on this point, more especially as it affected a very important article of food. The composition of ordinary milk, as stated by Fownes, is as follows:—

Water .. .. .	873.00
Butter .. .. .	30.00
Casein .. .. .	48.20
Milk sugar .. .. .	43.90
Phosphate of lime .. .. .	2.31
Phosphate of magnesia .. .. .	0.42
Phosphate of iron .. .. .	0.07
Chloride of potassium .. .. .	1.44
Chloride of sodium .. .. .	0.24
Soda in combination with casein .. .. .	0.42
1000.00	

\* Read before the Manchester Literary and Philosophical Society, November 30th, 1869.



## Composition of casein in 100 parts:—

Carbon..							53.83
Hydrogen ..							7.15
Nitrogen ..							15.64
Oxygen							23.37
Sulphur }							
							<hr/>
							100.00

## Composition of albumen in 100 parts:—

Carbon .. .. .	53.5
Hydrogen .. .. .	7.0
Nitrogen .. .. .	15.5
Oxygen .. .. .	22.0
Phosphorus .. .. .	0.4
Sulphur .. .. .	1.6
<hr/>	
100.00	

Casein and animal albumen are remarkably similar in composition; casein differs in not being coagulated by heat, and is precipitated by acetic acid. Certain animal substances cause its coagulation, such as the dried stomach of the calf, known as rennet, used in the manufacture of cheese.

When a thin film of milk is examined with the microscope, it is found to be a transparent fluid, in which are floating numerous transparent globules of fat; these are surrounded by a thin pellicle, and when this pellicle is broken mechanically, as by churning, the fat is liberated and forms butter. The fluid part consists of casein, saccharine matter, and salts in solution. The proportion of these organic principles varies in different animals, and also in the same animal when fed under different conditions. Human milk usually contains a larger proportion of sugar than cow milk, and is coagulated with greater difficulty. It is well known that the secretion and quality of milk is influenced by the mental emotions. Milk as obtained in towns is frequently adulterated, and as foreign matter would alter its microscopical characteristics, it was necessary to procure pure milk. One of our members, Mr. Kipping, kindly supplied me with a bottle of fresh-drawn milk. The cow had calved about three months previously, and had been fed on grass, bran, and bean-flour. This milk was examined soon after I received it, and was found to be very rich in oleaginous globules, forming a plentiful supply of cream. There was no appearance of dotted matter or any fungoid growth when examined by powers varying from 200 to 1500. The smallest oil globules exhibited (as usual) great molecular activity. A bottle was filled with some of this milk and securely corked; other portions of the milk were placed in open cups; one cup was kept in a cabinet which was closed during the day, the milk of the second cup was placed in a closet, the atmosphere of which I knew to be favourable to the growth of fungi, the *Mucor Mucedo* being the most abundant and of the same family as that mentioned as having been found in cream by M. V. Essling. The milk in the bottle and that in the cups was examined daily, precautions being taken to close the bottle speedily after a portion was removed. On the third day, the milk in the open cups was sour to the smell, but no change appeared visible under the microscope; the upper portion of the milk in the bottle had become very rich in oil globules by the formation of cream. On the fourth day, the casein had coagulated in the milk in the open cups, and the flaky precipitate was visible under the microscope; the pellicle surrounding the oil globules now appeared to be very easily ruptured, and with the slightest pressure some of the globules could be joined together—sometimes a number of globules which had been ranged in line by a current would coalesce by a slight movement of the fluid, and form an elongated mass. Fifth day, no appreciable alteration. Sixth day, the milk which had been placed in the closet had patches of mould visible on its surface; a microscopical examination of this mould showed it to be the *Mucor Mucedo*, such as I had frequently found on fruit which had been left in this closet.

The fungi appeared on the surface only, no trace of it could be found in the milk taken from various depths. The milk in the cup kept in the cabinet exhibited no appearance of the *Mucor Mucedo* or any other vegetable or animal organism; it had become thickened into a pasty mass, with an intensely sour odour. These observations were continued for eleven days, and the only difference observable was in the oil globules—they began to lose their spherical form, as if the investing pellicle had been weakened in parts and had become expanded.

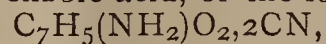
These experiments were repeated with a second supply of milk, which Mr. Kipping kindly supplied, and the results were alike in both cases. The range of temperature during the experiments was from 45° to 63° F. These experiments would lead me to believe that vegetable organisms do not, as a rule, make their appearance in pure unadulterated milk, unless it is exposed for some time to atmospheric influences; most probably the spores are supplied by the atmosphere. Further experiments are wanting to decide the question. The microscopical examinations should be continued in hot weather. I hope to be able to resume the enquiry next summer under different conditions, which have suggested themselves during the examinations I have detailed. In any case, M. V. Essling's suggestion to bottle the milk is very good, and, in my opinion, cream pans with covers would be a very great improvement on the open ones as at present employed, at the same time having due regard to the cleanliness of the apartment and vessels in which the milk is kept.

In a microscopical examination such as I have recorded it is quite necessary to have pure materials. The milk as supplied by vendors we know to be very frequently adulterated, and the most simple and easy method is by the addition of water. We know also that in towns where the water has a high character for purity, it sometimes happens in dry hot weather the reservoirs are charged with vegetable and animal organisms. Milk may not always have town's water added to it; in this case there may be an extra quantity of vitalised matter introduced. What a surprising account a microscopist might furnish from the examination of milk containing such an importation! In the cold weather, such as we have at present, animal organisms are not so abundant, and this may account for their absence from a sample of milk obtained in this town, in which I found *Algæ*, but not belonging to the pure milk. One curious circumstance was noticed in this milk, no *Mucor Mucedo* appeared in or on it, although exposed in the closet for the same length of time as Mr. Kipping's milk, which showed signs of this growth on the sixth day, and on the twelfth day the town milk had none visible. I may mention that pure milk in a bottle securely corked remained fresh twelve days; possibly the low temperature favoured its preservation.

# ON THE ACTION OF CYANOGEN ON ANTHRANILIC ACID.\*

By P. GRIESS, F.R.S.

SOME time ago,† I pointed out the action which takes place when cyanogen gas is passed into an alcoholic solution of amidobenzoic acid. The principal product of this reaction is, as I have shown, a yellow compound of cyanogen and amidobenzoic acid, of the formula—



which separates in large quantities as soon as the alcoholic solution of amidobenzoic acid is nearly saturated with cyanogen. When anthranilic acid (a body isomeric with amidobenzoic acid) is submitted, under the same condition, to the same reagent, a totally different reaction

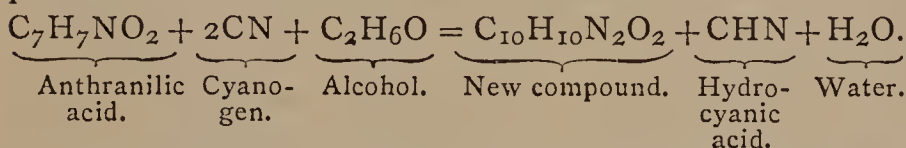
\* A paper communicated to the Royal Society.

† *Zeitschrift für Chemie*, new series, vol. iii., p. 533, and vol. iv., p. 389.



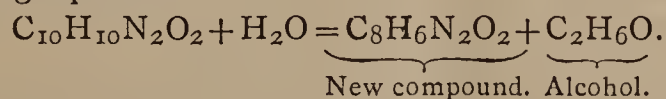
takes place. In this case, the solution remains either perfectly clear, or only traces of a similar yellow compound are precipitated. By allowing the alcoholic solution of anthranilic acid saturated with cyanogen to stand for several days, the acid is almost entirely converted into a new compound of the empirical formula  $C_{10}H_{10}N_2O_2$ ; two other new compounds (an acid and an indifferent body) are at the same time formed. It is worthy of remark that none of these compounds are isomeric with any of the bodies which, by the same process, are formed from amidobenzoic acid. Each of them belongs to a different type.

I propose, on this occasion, to treat only of the principal product of the reaction—viz., the compound  $C_{10}H_{10}N_2O_2$ . It is prepared in the following manner:—An alcoholic solution of anthranilic acid is saturated with cyanogen gas, and left to stand for about eight days. The alcohol is then evaporated at a low temperature, and the crystalline residue washed several times with dilute solution of carbonate of ammonia, by which any traces of the new acid (one of the by-products of the reaction) are removed. It is then further purified, by re-crystallisation from alcohol, with the addition of a little animal charcoal. The indifferent body already referred to, which is very little soluble in alcohol, is thus separated. The new compound,  $C_{10}H_{10}N_2O_2$ , is then obtained in the form of white acicular crystals, which are very little soluble in boiling water, but dissolve readily in boiling alcohol and ether. It fuses at  $173^\circ C.$ , and can be distilled in small quantities, without undergoing decomposition. Its formation may be expressed as follows:—



According to this equation, alcohol, as well as anthranilic acid and cyanogen, take place in the reaction. Confirmatory experiments which I have made show that the compound in question is really an ether.

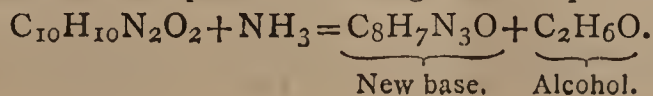
*Action of Hydrochloric Acid upon the Compound  $C_{10}H_{10}N_2O_2$ .*—Ordinary hydrochloric acid dissolves this body, and, when cold, does not act upon it. On boiling, however, speedy decomposition sets in, and a new body separates, the formation of which is represented by the following equation:—



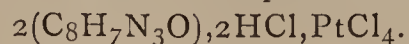
This new compound,  $C_8H_6N_2O_2$ , is very difficultly soluble in boiling water, alcohol, and ether, and crystallises in small white brilliant plates. It is likewise dissolved by solutions of caustic alkalies, but is again, however, separated by carbonic acid. On adding a solution of silver salt to its aqueous or alcoholic solution (neither of which has any action on vegetable colours), a white precipitate is formed. Fuming nitric acid converts this body into a nitro-compound, crystallising in honey-yellow prisms, of the composition  $C_8H_5(NO_2)N_2O_2$ . On treating the latter with sulphide of ammonium, or with tin and hydrochloric acid, it is reduced, and furnishes a basic amido-compound, crystallising in slightly yellowish-tinted needles, difficultly soluble in all neutral liquids. Its composition is  $C_8H_5(NH_2)N_2O_2$ . Compounds of this amido-body, with acids, crystallise well generally, but are, for the most part, difficultly soluble.

*Action of Ammonia on the Compound  $C_{10}H_{10}N_2O_2$ .*—On digesting the body for several days, at  $100^\circ C.$ , in sealed tubes, with alcoholic ammonia, it is gradually converted into a base, almost insoluble in water, and difficultly soluble in boiling alcohol. From this, it crystallises in brilliant nacreous plates.

Its composition agrees with the formula  $C_8H_7N_3O$ , and its formation takes place according to the equation—



This new base is monacid. Its nitrate is especially characteristic, for it is almost insoluble in water and alcohol. It separates out from very dilute solutions of the base, in the form of small white plates, on the addition of nitric acid. Its platinum-salt crystallises in thick yellow needles, and has the composition—



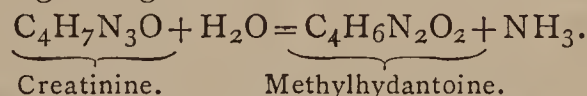
The compounds just described may, one and all, be viewed as substitution products of anthranilic acid, viz.:—

Anthranilic acid .. ..	$C_7H_7NO_2$	$= C_7H_6NO.HO.$
New ether .. ..	$C_{10}H_{10}N_2O_2$	$= C_7H_5(CN)NO.C_2H_5O.$
Product of decomposition of the former with HCl .. ..	$C_8H_6N_2O_2$	$= C_7H_5(CN)NO.HO$
Nitro-compound .. ..	$C_8H_5(NO_2)N_2O_2$	$= C_7H_4(NO_2)(CN)NO.HO.$
Amido-compound .. ..	$C_8H_5(NH_2)N_2O_2$	$= C_7H_4(NH_2)(CN)NO.HO.$
Base obtained from the ether by the action of $NH_3$ ..	$C_8H_7N_3O$	$= C_7H_5(CN)NO.H_2N.$

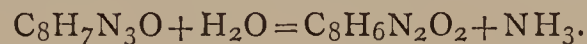
As I intend taking an early opportunity of considering the rational constitution of these bodies somewhat more fully, I content myself, for the present, with remarking that I am inclined to regard the base  $C_8H_7N_3O$  as the creatinine of the benzoic series; it stands to anthranilic acid exactly in the same relation as creatinine *par excellence* does to sarcosine—

$C_8H_7N_3O.$	$C_4H_7N_3O.$
Benzo-creatinine.	Creatinine.
$C_7H_7NO_2.$	$C_3H_7NO_2.$
Anthranilic acid.	Sarcosine.

Herr Neubauer has shown\* that creatinine, when treated in a sealed tube with baryta-water, undergoes the following change:—



I consider it highly probable that the base  $C_8H_7N_3O$  will split up in like manner, with the formation of the above-described compound,  $C_8H_6N_2O_2$ , according to the equation—



Indeed, this latter compound exhibits great resemblance in its chemical deportment to the methylhydantoin of Herrn Neubauer.

In conclusion, I should point out that the azodioxindol described by Herrn Baeyer and Knop, in their paper "On Indigo Blue," is isomeric with the before-mentioned compound,  $C_8H_6N_2O_2$ . These two bodies show, moreover, great similarity in other respects, so much so that I should feel inclined to view them as identical, if their fusing points did not differ essentially. Herrn Baeyer and Knop state that the fusing point of their azodioxindol is  $300^\circ C.$ ; while the compound I obtained fuses above  $350^\circ C.$  Should it turn out, however, on further investigation, that the two bodies are identical, the compound  $C_8H_6N_2O_2$  would have to be regarded as the first derivative of indigo which has ever been prepared synthetically, and which, like indigo blue itself, contains 8 atoms of carbon.

#### ON THE

#### SUCCESSIVE ACTION OF SODIUM AND IODIDE OF ETHYL ON ACETIC ETHER.†

By J. ALFRED WANKLYN.

IN a remarkable paper which appeared in the *Philosophical Transactions* (vol. clvi., p. 37, 1866), Frankland and Duppa described the products obtained on treatment with iodide of ethyl of the yellow wax-like mass given by the action of sodium on acetic ether. Besides the description

\* *Ann. der Chem. und Pharm.*, vol. cxl., p. 26.

† A paper communicated to the Royal Society.



of the compounds, Frankland and Duppa give a theory of their origin, which theory is embodied in four equations, expressive of Frankland and Duppa's view of the origin of the wax-like mass. As I have already pointed out, each one of these four equations affirms the evolution of an equivalent of hydrogen by every equivalent of sodium employed.

It is an established fact that neither acetic ether, nor any other ether, ever evolves hydrogen by reaction with the alkali metals. All equations which assume evolution of hydrogen in these reactions are, therefore, inadmissible.

At the end of my paper in the January number of Liebig's *Annalen*, I promised to give an explanation of Frankland and Duppa's products, which should not involve the assumption of evolution of hydrogen. That explanation I now give.

On reference to Frankland and Duppa's paper just cited, it will be found that the products described by them as obtained from the "wax-like mass" and iodide of ethyl are the following:—

- (A).  $C_8H_{14}O_3$ , liquid boiling at  $195^\circ C$ .  
(B).  $C_{10}H_{18}O_3$ , liquid boiling at  $210^\circ C$ . to  $212^\circ C$ .

butyric ether, caproic ether, and also some unacted-upon acetic ether, and a considerable quantity of common ethylic ether.

The history of these compounds is, therefore, the task set before me.

I have already shown that the direct products of the action of sodium on acetic ether are ethylate of sodium and sodium-triacetyl. Nothing else seems to be produced directly; but the excess of acetic ether, which is necessarily taken, acts on some of the ethylate of sodium, producing alcohol and acetate of ethylene-sodium in the manner described by me on a former occasion. (Of course, the extent to which this secondary action takes place will be determined by the exact circumstances of the experiment). We have, therefore, in the wax-like mass, got, by prolonging the action of sodium on acetic ether—

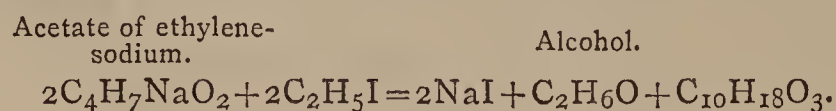
Ethylate of sodium .. ..	$C_2H_5NaO$ .
Sodium-triacetyl .. ..	$C_6H_9O_3Na$ .
Acetate of ethylene-sodium	$C_4H_7NaO_2$ .
Alcohol .. .. .	$C_2H_6O$ .

On the first three, iodide of ethyl acts, giving iodide of sodium and organic liquids.

From the ethylate of sodium comes the common ether.

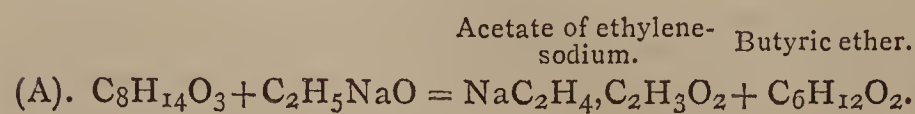
From the sodium-triacetyl comes ethyl-triacetyl, which is  $A = C_8H_{14}O_3$ , having been got by Geuther from the pure sodium-triacetyl.

From isolated acetate of ethylene-sodium and iodide of ethylene, I have recently obtained liquid B ( $C_{10}H_{18}O_3$ ) thus:—

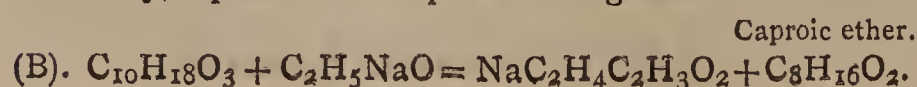


The liquid prepared by me boiled at  $212^\circ C$ ., and gave carbonate of baryta with baryta-water, and was identical with Frankland and Duppa's liquid B.

By the action of liquid A upon ethylate of sodium, Geuther has recently shown that butyric ether is produced. Geuther's reaction I write thus:—



Finally, I predict that liquid B will give—



## ON MICROSCOPICAL MANIPULATION.\*

By W. T. SUFFOLK, F.R.M.S.

(Continued from vol. xx., p. 320.)

FROM the explanation already given of the various modes in which light may be polarised, it is evident that one-half of the illuminating power is thrown away by the use of the polarising prism; this loss becomes a very serious matter when high magnifying powers are used, and as much valuable work is to be done by employing polarised light in combination with objectives of  $\frac{1}{2}$  inch and shorter focus, it becomes necessary to find some means of increasing the intensity of the illuminating pencil under such circumstances. Polarised light can be concentrated by lenses in the same manner as common light, and, after condensation, still retains its peculiar properties. In large microscopes, provision is made for fitting the Nicol prism below the achromatic condenser, and a set of Darker's selenites between them; this, with a good tourmaline or Herepathite for an analyser, will enable observations to be carried on with very high powers, and with nearly the same ease as by ordinary illumination. With small microscopes, Collins's Webster condenser, which is constructed to carry a Nicol prism, will be found a very efficient illuminator, as its lenses are large, and it supplies an excess of light when used without diaphragms, it will be found very suitable for polarising purposes. Its capability of being adapted to any instrument is another recommendation. The author can speak favourably of its performance with his own microscope, in which the unusually short distance between the stage and mirror prevents the use of any other condenser. The selenites can be placed between the Nicol prism and the condenser, as usual in microscopes with substage fittings, but with small instruments the stage arrangement must be used; the focus of the Webster is sufficiently long to work through the three selenites without material injury to the illumination, when Mr. Bailey's or other thin mounting is employed.

In carrying on observations by the aid of polarised light, it is necessary that the substance to be examined should be rendered as transparent as possible, by immersion in a suitable medium. Those which render objects so transparent that the details are almost invisible under ordinary illumination, are in general very suitable for polariscope purposes.

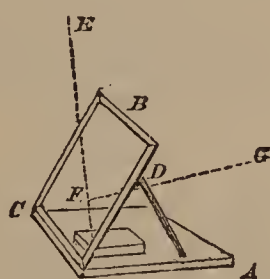
The facts which polarised light reveals are principally differences of density in tissues, the existence of which we should not be aware of without such aid. With regard to crystals, the polariscope at once distinguishes those which belong to the cubic system, such as common salt, which has no doubly refractive power, and, in common language, does not polarise from those of the other systems, which, owing to their double refraction, are among the most brilliant of polariscope objects. Not only differences of density are made evident by the use of polarised light, but also minute variations of thickness when the substance examined is possessed of doubly refractive properties, which are at once shown by a difference of colour, which defines the boundaries of the thickened portion, although this from the hyaline nature of the substance might be perfectly invisible

\* The substance of a course of lectures delivered to the members of the Quekett Microscopical Club, January—April, 1869.



when illuminated in the ordinary manner. This is very often the case with the secondary deposits in vegetable tissues, which are to be seen most clearly when viewed with polarised light and sufficiently high powers. Sections of such substances as horn and tissues resembling it, as whalebone, &c., which exhibit little or no structure with common light, at once display differences of density indicated by colour when examined with the polarising microscope. A very interesting microscopic object is made by Mr. Bailey, consisting of a bar of glass, which is capable of being pressed by a screw. This, when examined by polarised light, exhibits no doubly refractive appearances so long as the screw does not touch it; but when pressure is applied, dark or coloured bands make their appearance around the point of the screw, extending to a greater or less distance, according to the amount of pressure employed, showing at once that some change has taken place in the molecular arrangement of the glass. Nearly similar bands are to be seen along the sides of a recent diamond cut and around the dot made by a slight blow of a steel centre punch, in both cases showing that the glass has been subjected to some strain. Opticians, in fitting lenses into cells, are careful to avoid pinching the glass, lest double refraction should be produced. Coloured bands are easily seen in pieces of thick plate-glass which have been rapidly cooled. These are best shown in Le-count's polariscope (Fig. 38), in which the polarised

FIG. 38.



ray, G, is made to pass twice through the piece of un-annealed glass, F, which very much increases the intensity of the coloured bands. In this simple instrument the bundle of glass plates, B, acts as a polariser by reflection, and at the same time as an analyser by refraction, the light being reflected from the bundle through the object, and returned through it by the mirror, c, the bundle analysing the polarised ray, F, on its passage through it to the eye at E. The colours produced by varying thicknesses of selenite may be seen with the microscope in a small piece, roughly split, and mounted in balsam. It will be found that there will be a change of colour at every difference of thickness.

The object should be viewed, in the first instance, with the selenite plate, and the appearances noted which present themselves when both analyser and polariser are rotated. If the construction of the microscope permit, the object itself should also be rotated. Should no effect be produced by the prisms alone, a selenite may be used, commencing with one of little retarding power as  $\frac{1}{4}$  of Darker's series. This should be rotated, and also the prisms before going through the various degrees of retardation.

Substances having a very feeble doubly refractive power are much assisted by using a selenite of suitable thickness, and details are often better seen with selenites of one colour than another. Darker's series offers great facilities for readily obtaining the most suitable tint. When a less power than that

given by the  $\frac{1}{4}$  is required, it can be obtained by turning the plate more or less towards one of the optic axes, which are situated at  $45^\circ$  from the P. A. mark, and the other depolarising axes. Also by using plates of mica, thin enough to just let a little light into the darkened field. Care should be taken to use sufficient light, and employ the condenser whenever necessary. As a general rule, with high powers, the light cannot be too strong; sometimes direct sunlight may be used with advantage. The effect of increase of illuminating power with the polariscope is not that of dilution, like excess of light pouring through a transparent coloured object, but as the coloured wave is augmented, intensity of colour and stronger definition is the result.

The polarising microscope is a great aid to the knowledge of structure, and an examination cannot in any way be considered as complete in which this most searching mode of investigation has been neglected. Hitherto, the polariscope has been considered rather in the light of a toy than as a valuable instrument of research, and it has therefore become necessary to devote so much of this elementary course of instruction to the application of polarised light to microscopical purposes.

(To be continued.)

## NOTICES OF BOOKS.

*Elementary Chemistry.* By the Rev. WILLIAM GRIST, Grammar School, Bewdley. Part I.—*The Elements.* Birmingham: Cornish Brothers. 16 pages; 8vo.

THE author of this work, imagining, we suppose, that there was a great dearth of elementary works on chemistry, determined to bring his own grist to the mill. We are greatly surprised that he could find a miller to grind it, and we pity those who may attempt to eat the bread which has resulted; for, without the least doubt, it will disagree with the first person who partakes heartily of it.

We have an account of the elements (which, the author informs us, "are more than sixty in number, more than fifty of which are metals") compassed in a span of sixteen small octavo pages. We can easily imagine how lengthy and lucid the descriptions of each element must be. For example, strontium receives the following amount of notice:—"This greatly resembles barium, but its salts are not poisonous. One of its salts is used in red-fire." While molybdenum has nearly a line devoted to it—"Molybdenum is white, brittle, and very infusible." What an example to prolix writers! What can be more terse than the above?

Now, as an example of the author's English, we may as well quote the first paragraph in the book:—"Chemistry is the science that has for its object the discovery, nature, properties, and combinations of the elementary substances, and also the laws which govern the production of their combinations." Again, in speaking of the non-metallic elements, he remarks, with singular perspicuity, "These may be divided into three groups—invisible gases, chlorine group, and (excepting iodine) solids." As to the author's Latin, he gives *Hydrargyrus* as the term for mercury. As to his general accuracy, he informs us that iodine is "obtained from the ashes of seaweed, after the soluble parts have been extracted;" that sulphur "melts at a little above the boiling point;" that the specific gravity of potassium is 0.086, of sodium 0.097, and of lithium 0.059; that sodium "becomes red-hot when it touches cold water, and burns with a bright yellow flame if the water be hot;" that "fire appears to be the effect of violent combustion." We will cease here. We will not



ask how, when, and where the author studied chemistry. We will not ask what has induced him to rush with such inconsiderate haste into print. We will not ask the aim, object, design of the work before us. But we will ask him if he is aware of the spirit which is abroad among our schools in regard to science teaching; if he knows of the many accurate, concise books by eminent men, written specially for the requirements of our schools; if he recognises the injury which he is doing by making public false science, inexact method, the truths of nature perverted by a sojourn in the caves of his mind, and returned maimed into the light of day.

At a time when the desire for sound training in science is becoming general, a work of this nature does infinite harm, and brings the contempt of the public both upon the science and its teacher. We recommend Mr. Grist to give up writing on chemistry; to devote as much time as he can spare to the study of it for the next twelve months, and then, if need be, to teach it by the help of some good work specially adapted for schools—such as the work of Roscoe, of Bloxam, of Harcourt and Madan, of Barff, &c.

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*Chemistry for Schools, an introduction to the Practical Study of Chemistry.* By C. HAUGHTON GILL, Assistant Examiner in Chemistry at the University of London. 100 Illustrations. London: James Walton, 1869. 315 pages.

THIS work is intended to be used as a manual for schools where chemistry forms a part of the ordinary routine work; and one of its main objects is the cultivation of "scientific habits of thought." It does not appear to differ materially from any of the many class-books which have appeared during the last few years; it is most nearly related to Dr. Williamson's "Chemistry" (Clarendon press series), and his nomenclature is followed. The text is somewhat uneven, and in another edition should be carefully examined; in one portion it is turgid, in another, rugged and clumsily constructed; thus the "genesis of ammonia," and the "change of proportional composition" is described in one place, while in another, we find such expressions as "got rid of," "a bit of this, a pinch of that," "the wood is re-lit with a little pop," "To do this, it is necessary to act on it by other bodies, which must be admitted to be what they are described to be," and so on. All this, however, refers to the diction only; the subject matter appears to be sound and well arranged. There is evidence of much hard work, and the book is eminently comprehensive; otherwise it is admirably printed, and of very convenient form, and we should be sorry to regard it as labour lost. The work is divided into twenty-two chapters; to each of which is appended a list of questions. The appendix contains a very useful chapter on "crystalline systems," illustrated by woodcuts of the typical forms. There is also a chapter on the metric system, by Mr. Walker, one of the Mathematical Masters in University College School, in which we find ready rules for various conversions; thus—"To convert kilomètres into miles, multiply by 5 and divide by 8. To convert mètres into yards, multiply by 35 and divide by 32. To convert decimètres into feet, divide by 3. To convert centimètres into inches, multiply by 4, and reject the last figure. To convert millimètres into inches, or decimals of the inch, multiply by 4, and point off the last two figures. To convert miles, yards, feet, inches, into metric equivalents, multiply by the divisors, and divide by the multipliers, as given above."

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*The Examination of Petroleum and other Mineral Oils according to the Petroleum Act, 1868.* By A. NORMAN TATE, Analytical Chemist, &c., &c. London: H. Greenwood. 1869.

THE author of this small pamphlet has, we think, done good service to all who have in any way to do with

petroleum or other mineral oils, by writing this very clear paper on a subject which, as is justly pointed out by its experienced author, is not so well defined as it ought to have been. The paper contains valuable and definite directions about the testing or ascertaining of what is termed the *flashing point*. We recommend the perusal of this pamphlet to all parties interested in this subject, and especially to those who by the Act are called to carry out the operative tests, viz., the inspectors of weights or measures, or other persons duly appointed to inspect weights and measures as testers of petroleum. We entirely approve of the author's remarks made on this score.

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*A Manual of Diet for the Invalid and Dyspeptic, with a Few Hints on Nursing.* By DUNCAN TURNER, Licentiate of the Royal College of Physicians, &c., &c. London: John Churchill and Sons. 1869.

THE object the author has sought in publishing this small essay is to convey, in a few words, avoiding as far as possible technical terms, necessary information to a larger class than would be expected from the title of the book, which contains six chapters and an appendix of formulæ. We find that the volume contains, written in a popular language, a great deal of useful hygienic information, and we heartily recommend it to all households, where, especially in the hands, or better still in the head, of the mistress, this useful knowledge deserves a permanent place. The appendix is highly commendable for its sound directions as regards the preparation and cooking of food, which has more to do with digestion than is commonly supposed in this country.

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## CHEMICAL NOTICES FROM FOREIGN SOURCES.

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*Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

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*Revue Hebdomadaire de Chimie*, December 9, 1869.

**Quantitative Estimation of Sulphur in Cast-Iron and Steel.**—M. Eggertz.—The process invented by this author is based upon the shade of colouration which small quantities of sulphuretted hydrogen produce upon pure silver, or certain alloys thereof. In a glass stoppered bottle, of 25 centimetres diameter and 15 decimetres height, a mixture is poured of 1 grm. of water and  $\frac{1}{2}$  a grm. of concentrated sulphuric acid, to which is added 1 decigram of the metal reduced to the finest possible powder. There suspend, by means of a very fine platinum wire, in the bottle, without touching the fluid, a clean piece of metallic silver, the platinum wire being held squeezed between the stopper and the neck of the bottle. The metal dissolves in a moderately warm room within a quarter of an hour, so that the silver can be taken out and examined after that time. The author has, by means of a series of experiments, been enabled to construct a series of numbers, representing, according to certain shades of colouration, the quantities of sulphur found.

**Drop Apparatus for Fluids.**—MM. Alvergnet, Frères.—This contrivance consists essentially of a flat-bottomed glass flask, round the top portion of which a caoutchouc balloon has been so arranged, that a glass tube bent downwards outside of the flask, and reaching straight down to the bottom, passes air-tight through the balloon. When the latter is compressed, the air it contains forces the liquid in the flask upwards; and this may be so managed as to cause it to flow drop by drop out of the bent tube.

Among the papers the titles of which we notice, but do not abstract, because they are too lengthy, and do not, moreover, belong to chemical science, are the following:—

**Process for the Reproduction of Pictures by Lithography and other means.**—M. Mielle.

**Furnace Constructed to Burn Spent Tan for the Purpose of Heating Steam-Boilers.**—MM. Durand, Frères, 17, Rue de Gobelius, Paris.



December 16, 1869.

**Aniline Blue.**—M. Blumer-Zweifel.—When either the tartrate, or hydrochlorate of aniline is brought under the influence of oxidising substances, it produces on tissues an intensely black colour; by a somewhat analogous process, the author obtains a blue which is stated to be as good as indigo blue. For printing, 100 grms. of dry starch are mixed with a litre of boiling water, to which is added 40 grms. of chlorate of potassa, from 3 to 4 grms. of sulphate of iron, 10 grms. of chloride of ammonium, and, after this mixture is cold, 60 grms. of the aniline salt.

**Vesuvine.**—M. Knosp.—Under this name, the author has brought into commerce a dye material belonging to the class of aniline dyes; but no further particulars are mentioned, as regards the preparation, or mode of obtaining the dye, which is reported to be sold in the state of paste and powder. This dye yields shades of bright, as well as deep orange and bright brown, and is suitable for dyeing silk, wool, and cotton; but this latter fabric has to undergo a series of mordanting processes before it is in proper state to receive the dye.

**Carbon-Japanis.**—Under this appellation, there has recently come into use for the purpose of paving, instead of asphalt, a mixture of coal-tar, and some chemicals not specified, and fine dry sand; this is stated to yield a very sound, hard, durable, and, at the same time, very cheap pavement.

December 23, 1869.

**Manufacture of Sulphide of Carbon.**—M. Contet.—As a proof of the greatly improved mode of manufacture of this substance and its very extensive use, the author begins by stating that, in 1840, the kilo. of rectified sulphide of carbon cost 50 francs (£2); in 1848, M. Deiss manufactured it and sold it at 8 francs per kilo., and now it may be had wholesale at 50 centimes the same quantity. The apparatus now in use consists of vertical retorts made of the same kind of clay as is in use for glass-pots; these retorts are 1·8 metre high by 0·50 internal diameter, they are lined internally with a glaze composed of 130 parts of flint glass, 20 parts of carbonate of soda, and 12 parts of boracic acid fused together, and next pulverised and painted on the inside of the retorts with gum water (at the first heating of the retorts this mixture yields a glaze which entirely closes the pores of the material, thus preventing escape of vapours and gases); four of these retorts are set in one oven made of brickwork, and are heated by a properly constructed furnace; the retorts are provided with the necessary tubes for the abduktion of the vapours of the sulphide of carbon, and the introduction of the charges of sulphur and charcoal; the operation once commenced is continuous, since the retorts last for at least six months; the consumption of sulphur per retort amounts to 125 kilos. in 24 hours, introduced in charges of 155 grms. each, every three minutes time; the vapours of the sulphide of carbon are collected and condensed in vessels made of zinc or sheet-iron, and shaped like flattened down casks, and entirely covered over with cold water constantly refreshed, while the contrivance is so arranged as to keep the sulphide under water also (its specific gravity is 1·265, and its boiling point 45°). The most suitable temperature for this manufacture is bright red heat; the raw liquid obtained has to be re-distilled, and this operation is conducted in large iron vessels, which contain some 5000 kilos. at the same time and communicate with six worm condensers; steam is used for heating by means of a serpentine-coiled set of pipes, and the liquid is heated to 48°; near the end of the distillation the temperature is raised to 100°, in order to drive off a raw product containing very much sulphur dissolved; in the distillatory apparatus some sulphur remains; which is removed and again applied; it appears that this industry has become very extended and is carried on with great success in France. This number contains the first portion of an interesting paper on the

**Analysis of Several Different Kinds of Extracts of Meat.**—M. Lebaïque.—Which we shall leave for the present and abstract only when it is quite finished.

**Lighting the Numbers of Street Doors at Nights.**—M. Méne states that the researches of a chemist have resulted in the production of a fluid which is painted on the numbers and causes the same to shine and be perfectly visible even in very dark nights; the process, about the nature of which nothing further is said, is stated to be simple, inexpensive, and not dangerous or injurious in any way; experiments made on the large scale have given satisfactory results.

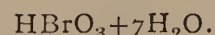
*Annalen der Physik und Chemie, von Poggendorff, No. 11, 1869.*

This number contains the following original papers:—

**Researches on Mica and Minerals Associated therewith.**—Dr. Bauer.

**Validity of the Law of Ohm for Electrolytes and a Numerical Determination of the Resistance to Conduction of Dilute Sulphuric Acid by Alternating Currents.**—MM. Kohbrausch and Nippoldt.—The concluding portion of a lengthy essay.

**Studies on the Oxygen Compounds of the Halogens.**—M. Kaemmerer.—In the introduction to this paper, the author suggests an alteration of the nomenclature for the following compounds in the sense thereby respectively expressed, the name now in use being between brackets:—Cl, chlorine; ClH, chloric acid (chlorsäure) (hydrochloric acid); ClHO, oxychloric acid (hypochlorous acid); ClHO<sub>2</sub>, dioxychloric acid (chlorous acid); ClHO<sub>3</sub>, trioxychloric acid (chloric acid); ClHO<sub>4</sub>, tetroxychloric acid (perchloric acid). The paper then treats of trioxybromic acid (which was prepared by the author in pure state from trioxybromate of silver) and its decomposition by means of bromine. This acid was proved to form a definite hydrate—



Trioxychloric acid forms a definite hydrate— $\text{HClO}_3 + 7\text{H}_2\text{O}$ . Sp. gr. at 14° = 1·282. When this hydrate is left standing *in vacuo* over sulphuric acid, the substance becomes more concentrated, and a momentary evolution of much gas takes place. This concentrated acid led to the formula  $2\text{HClO}_3 + 9\text{H}_2\text{O}$ . Trioxiodic acid forms a hydrate,  $2\text{HIO}_3 + 9\text{H}_2\text{O}$ . Sp. gr. at 13°, 2·1269. Pure, solid, and crystalline anhydrous trioxiodic acid: sp. gr. at 9°, 4·7987.

**Comparative Scale for Spectra.**—M. Weinhold.—The subject is entirely treated algebraically.

**Experiments on Boiling.**—M. Krebs.—The author investigates in this portion of his paper, and illustrates, by diagrams and descriptions of experiments, some of the less well-known and defined causes of steam-boiler explosions.

**Mineralogical Communications.**—M. G. Vom Rath.—This is the eighth part of a lengthy monograph, chiefly of crystallographico-mineralogical interest. Among the recent chemical analyses it contains, we quote:—*Oligoklase*, from Vesuvius. In 100 parts:—Si, 29·38; Al, 12·48; Ca, 2·06; K, 2·21; Na, 5·51; O, 47·06. *Andesin*. In 100 parts:—Na, 11·36; Al, 13·54; Si, 27·67; O, 47·43.

**Lightning without Thunder.**—T. Hoh.—The author states that the phenomenon seen by him at Bamberg (Bavaria) during the night of the 26th of July last was altogether distinct from the so-called *Wetterleuchten* (sheet-lightning), and that, although quite close to him, he did not perceive the least sound or report, which follows sharp and well-defined lightning. There was no wind, and the night very quiet. Bamberg only contains a population of about 26000; and, since the phenomenon was seen about midnight, there was no noise to prevent even thunder at a distance to be heard.

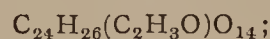
*Journal für Praktische Chemie, No. 13, 1869.*

This number opens with a brief obituary of the founder of this periodical, Otto Linné Erdmann, M.D., Ph.D., born at Dresden, April 11th, 1804, and who died on the 9th of October last. The deceased was Professor of Chemistry at Leipzig, and founder of this periodical in 1828. His three chief co-editors (Messrs. Schweigger-Peidel, Marchand, and Werthor) all died before him. Dr. Erdmann's name is connected with many valuable contributions to science.

The original papers are the following:—

**Derivatives of Propan (Propylhydride).**—No author's name.—By means of a rather lengthy process, the author obtained a body,  $\text{C}_3\text{H}_{12}\text{O}_2$ ; but how this substance originated could not be made out. The main conclusion derived from the results of the experiments is that the general method to bring secondary alcohols to primary is as follows:—The iodine of the secondary iodides is displaced by hydrogen in the nascent state. The hydrocarbon so generated is acted upon by chlorine, whereby primary chlorides are formed. When propan is chlorinated, chloride of propylene,  $\text{CH}_3\text{—CHCl—CH}_2\text{Cl}$ , is formed. This, the author states, could hereby be expected, since, when ethan,  $\text{C}_2\text{H}_6$ , is chlorinated, chloride of ethylene,  $\text{CH}_3\text{—CHCl}_2$ , is formed.

**Pigment Contained in Yellow Berries.**—No author's name.—The colouring matter is insoluble in water. It is named rhamnagin. Formula,  $\text{C}_{24}\text{H}_{32}\text{O}_{14}\text{H}_2\text{O}$ . When acted upon by sulphuric acid, it is split up into rhamnetin and sugar, rhamnetin,  $\text{C}_{12}\text{H}_{10}\text{O}_5$ , and  $2(\text{C}_6\text{H}_{14}\text{O}_8)$ . When rhamnagin is heated to 140° alone with anhydrous acetic acid, the result is the formation of a substance insoluble in water—



while rhamnetin, treated in the same manner, yields a solid substance soluble in alcohol— $\text{C}_{12}\text{H}_8(\text{C}_2\text{H}_3\text{O})_2\text{O}_5$ .

**New Volatile and Saccharine Substance from the Caoutchouc of Gaboon.**—M. Girard.—The author finds, in the caoutchouc imported from the French settlement of Gaboon (West Coast of Africa), a substance which he calls *Dambonite*. It is a white-coloured, solid body. Taste sweet; very soluble in water; difficultly so in absolute alcohol; fuses at 190°; and may be sublimed at 200° to 210° without decomposition. In its crystalline state, its formula is  $\text{C}_8\text{H}_8\text{O}_6$ . When submitted to the action of fuming hydriodic acid, it is split up into *Dambose* and iodide of methyl;  $\text{C}_8\text{H}_8\text{O}_6 + \text{HI} = \text{C}_6\text{H}_6\text{O}_6 + \text{C}_2\text{H}_3\text{I}$ . *Dambose* is an anhydrous glucose, capable of crystallisation, insoluble in absolute alcohol.

**On Rufigallic Acid.**—M. Lüwe.—After referring to the labours of M. Robiquet and others on this subject, the author states that, when rufigallic acid is pure, it is insoluble in water, either hot or cold, difficultly soluble in ether and alcohol, and exhibiting a red-brown powder not unlike amorphous phosphorus. Average composition in 100 parts:—C, 54·449; H, 2·697; the rest being O. Formula,  $\text{C}_{20}\text{H}_6\text{O}_{12}$ .

No. 14, 1869.

This number contains the following original papers:—

**Contribution to the Qualitative Analysis and Detection of Dyes and Colours Imparted to Textile Fibres.**—M. Stein.—This paper is to be considered as an introduction to an essay the author intends to publish on this subject, which is, indeed, a far more difficult one than is generally believed. The author gives some instances, stating that not only the material of the dye, but the duration of exposure to the dye-bath, mordants applied, the mode of cleansing (*avivage*), all concur to influence the qualitative detection of even one and the same dye material; as a general rule all dyes fixed by means of tin mordants are faster than those fixed by means of alumina mordants, and all dyes fixed without any mordant at all are more or



less easily dissolved from the textile fibres. This portion of the paper treats further on blue dyes, of which, under the heading of simple (*einfach*) four kinds are enumerated, viz., (1) Indigo applied in two different ways, so-called "vat blue" and "Saxony blue;" (2) Prussian blue or cyanogen blue; (3) Blue from various dye woods; (4) Aniline blue. Mixed blue dyes.—The different qualitative tests and the mode of their application are given at full length, of which the following is a condensed abstract:—I. Heat the material to be tested with alcohol of 80 per cent and a few drops of hydrochloric acid. A. The material is reddened, and yields a red liquor. Blue from dye woods.—B. The material retains its blue colour; the fluid becomes blue coloured: (1) Aniline blue; (2) Saxony blue. C. The material remains unchanged; liquor not coloured: (1) Vat blue; (2) Cyanogen blue. II. Further treatment of the materials sub B and C. B. The fabrics is tested with strong sulphuric acid; no change occurring indicates Saxony blue. When the colour changes to brownish yellow or brownish red, aniline blue is present. C. Heat with a solution of soda; no change of colour occurring indicates vat blue. When, on the other hand, this reagent causes either complete discolouration or turning to yellow or brown, cyanogen blue is indicated. It should be observed that a series of confirmatory tests are required and given at length, but space forbids to enter into further particulars.

**Meteoric Iron Fallen on the Collina di Brianza (Milanese Territory).**—Dr. Hausofer.—The author has made a careful analysis of a piece of this very large meteorite, about the origin of which some doubt has existed. The specific gravity of this material is 7.596; it does not contain sulphur or chromium, and was found to consist, in 100 parts—of iron, 91.1; nickel, 7.7; phosphorus, 0.3; cobalt, 0.2; and traces of carbon.

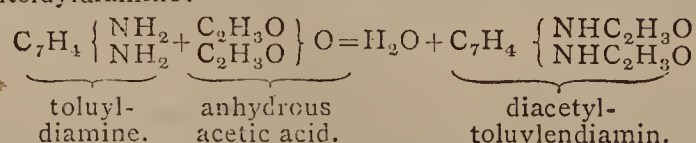
**Meteorite Found near Cranbourne, Australia.**—Dr. Hausofer.—Specific gravity, 3.744; contains, in 100 parts—insoluble silicates, 4.1; silica, 2.3; alumina, 1.5; lime, 1.8; phosphoric acid, 1.4; protoxide of iron, 7.1; protoxide of nickel, 3.1; water, 13.7. The hardness of this substance is about the same as that of felspar.

**Action of Chloro-Chromic Acid (Chromsaurechlorid) Upon Benzol.**—Dr. Carstausen.—The author first reviews the labours of M. Carius and others to obtain the direct oxidation of benzol, and then states that it occurred to him that chloro-chromic acid might be used for this purpose. The action of that substance upon benzol is, however, so violent that the chloride aforesaid cannot be used undiluted; as a diluent, liquid glacial acetic acid is used, and in this manner there is obtained, after proper purification, a substance, trichlorchinon,  $C_6HCl_3O_2$ . This material is crystalline, soluble in boiling alcohol, and its origin from benzol is explained by the following formula:— $4(CrO_2Cl_2) + C_6H_6 = C_6HCl_3O_2 + 2Cr_2O_3 + 5HCl$ . When chloro-chromic acid contains any free chlorine, there is also formed some tetrachlorchinon and a peculiar heavy oily substance.

**Combination of Tantalum and Niobium.**—M. Rammelsberg.—The author has undertaken this very laborious research in order to test the correctness of the labours of Messrs. Blomstrand and Marignac on this subject, and also to vindicate the correctness of the researches of the late M. H. Rose; the headings of the chapters of this monograph are: tantalum, atomic weight of tantalum, chloride of tantalum, bromide and iodide of tantalum, fluorides and double fluorides of tantalum, tantalic acid, salts of tantalic acid, lower oxides of tantalum, nitride of tantalum; this paper is to be continued.

**On Chrysophanic Acid.**—Dr. Rochleder.—After referring at some length to the labours of many chemists, as well as those made by himself on this subject some years ago, the author enters into a discussion on the statements made by MM. Graebe and Liebermann respecting the composition of chrysophanic acid, and then says, that he has taken the trouble to prepare this acid in pure state from rheme as prepared by Dr. Marquardt at Bonn; this substance consists mainly of chrysophanic acid, emodine, and impurities; the composition of pure emodine dried at 100° is, in 100 parts, C, 65.75; H, 4.29; O, 30.18; formula:  $C_{40}H_{20}O_{13}$ ; the formula which Messrs. Graebe and Liebermann give for chrysophanic acid, viz.,  $C_{14}H_8O_4$ , cannot, according to the author of this paper, be the correct one, and this the less so, as no less than six different chemists have found for the formulæ of this substance, prepared from different sources and at various periods, the formula,  $C_{56}H_{42}O_{17} = 4(C_{14}H_{10}O_4) + H_2O$ , because the  $H_2O$  of crystallisation is only driven off at 115°; it should be kept in view that emodine is very difficult to separate from chrysophanic acid, and M. Rochleder suspects that the statements of Messrs. Graebe and Liebermann about the action of pulverised zinc upon chrysophanic acid are vitiated by the presence of emodine in the acid used for these experiments.

**On Toluyldiamine.**—M. Koch.—This substance, a bye product of the manufacture of aniline, is readily and rather violently acted upon by anhydrous acetic acid, the result being the formation of diacetyltoluyldiamine:—



This latter compound yields, on being heated to 150° with 1 eq. of carbonate of soda, an acetyl, and is thereby converted into monoacetyldiamine; the diacetyl compound is, by the addition of bromine, converted into monobromodiacetyltoluyldiamine,



a solid substance crystallising in needle-shaped crystals, when this compound is heated to 130° along with an excess of caustic potassa solution it is converted into monobromoacetyltoluyldiamine.

*Les Mondes*, December 23, 1869.

**Estimation of the Value of Sugars for Commercial Purposes.**—M. Méhay.—The author proposes that the brokers should supply standard samples of refined sugar, which should be considered as pure, for all commercial purposes, and that every assay, of any kind of sugar, whether made by means of the optical saccharimeter or by the Frommherz-Barreswil process, should be compared with an assay of the standard sample made at the same time. The samples of raw sugar marked from No. 1 to 21, adopted by the Netherlands' Society for Trade and Commerce, have been found, by repeated assays, to represent very accurately the value, and each to contain, according to the specific number, the percentage of pure sugar found therein by rigorous analytical methods; and with these samples properly marked and guaranteed genuine any analyst can be supplied by brokers. On the Continent, raw sugars are generally denominated No. so and so, by which the different qualities are readily discriminated, bought, and sold.

**Falling Stars.**—The Rev. Father Denza, S.J.—A very interesting and extensive account of observations made at nineteen different places in Italy, from Palermo to Moncalieri and Milano, giving for every locality the number of meteorites seen and observed at observatories during a given time.

**Obituary.**—The well-known scientific chemist, Stephane Robinet, who was born at Paris, on the 6th of December, 1796, died at that city on the 3rd of December, last. The deceased is especially known for his zeal in analysing the natural waters of France, and for his excellent hydrographical works.

*Cosmos*, December 25, 1869.

**Permeability of Caoutchouc Tubes.**—M. Jouant.—The author states that, from a series of experiments he has made, the following conclusions may be drawn:—A vulcanised caoutchouc tube of 1.2 m.m. thickness, and having a surface of 33.60 sq. m.m., loses, in three days, by diffusion, 21.3 per cent of hydrogen, while 11.2 per cent of air has at the same time entered. That the non-vulcanised caoutchouc tubing is by far less permeable for gases is proved by the following facts:—A tube of the last-named substance, having 50.00 sq. m.m. surface, has been submitted to the same experiment during twenty-eight days, and lost during that time, by diffusion, 22.6 per cent of hydrogen, while only 5.6 per cent of atmospheric air entered the apparatus, which was arranged precisely alike for both experiments, and so constructed as to indicate any change of pressure going on internally by means of manometer tubes. The permeability of caoutchouc for gases is a well-established fact, and a consequence of its peculiar structure.

## NOTES AND QUERIES.

**Alumina from the Island of Eubæa.**—Can any of your correspondents inform me about the "Alumina" obtained from the Island of Eubæa, its price, and through whom it may be obtained. Samples required, which would probably lead to business.—J. E. N.

**Dissolving Resin in Water.**—(Answer to J. Milton).—You cannot dissolve resins in water as you can salt, or sugar, or gum; but shellac, for instance, may be rendered soluble in water by means of a solution of borax, and by means of aqueous solutions of caustic and carbonated alkalies, many (not all) resins may be rendered what can be termed soluble in water; but in reality this is attended with a kind of saponification similar to that which occurs when neutral fats are treated with caustic alkalies, thereby becoming soluble soaps.

## MEETINGS FOR THE WEEK.

MONDAY, 10th.—Medical, 8.  
TUESDAY, 11th.—Photographic, 8.  
WEDNESDAY, 12th.—Society of Arts, 8.  
— Microscopical, 8.  
THURSDAY, 13th.—London Institution, 7.30.  
— Royal, 8.30.  
— Zoological, 8.30.  
— Royal Society Club, 6.  
FRIDAY, 14th.—Quekett Club, 8.

## TO CORRESPONDENTS.

**L. Nightingale.**—Any good work on agricultural chemistry will give you the information you seek.

**V. A. U.**—The copyright will belong to the proprietor of the magazine, unless you stipulate for its reservation when sending the article.

**H. H.**—1. Some excellent lectures on coal-gas appeared some little time ago in the *CHEMICAL NEWS*: consult these. 2. Mulder on the "Chemistry of Beer."

**James Wyld's** courteous letter in reference to the *Electric Telegraph Review* is received, with thanks, and shall meet with due attention.

**R. C. Moffat, Ph.D.**—1. The index is issued with the present number. Its great length and the care required in its preparation have rendered the delay of a week necessary. 2. Browning and Co., Minorities, or Horne and Thornthwaite, Newgate Street.



# THE CHEMICAL NEWS.

VOL. XXI. No. 529.

## ON A MINERAL FROM SAN PAOLO.

By Dr. T. L. PHIPSON, F.C.S.,  
Member of the Chemical Society of Paris.

A MINERAL from San Paolo, Brazil, was placed in my hands a short time ago in Paris; it was supposed to be a silicate of yttria, and was called Thelline or Thellite. It corresponded in appearance and properties with the silicate of yttria, described by M. Damour, in 1858, as having been found in the diamond sands of Bahia, Brazil; a brown mineral, said to be "probably a silicate of yttria," which whitens before the blowpipe, but does not fuse, and was found to be insoluble in phosphorus-salt.

A small sample of the specimen from San Paolo was confided to me for analysis, with a request that I would make known the result at an early opportunity.

The following is a description of the mineral and its analysis:—It is of a light brown colour, translucent on the thin edges, and in the veins which traverse its substance; when pulverised it gives a light yellow powder of great brilliancy, which becomes bright red when heated; it is partially attacked by strong acids. Before the blowpipe it is infusible, but darkens and turns black in the inner flame, and, by continuing the heat for some time, the surface becomes quite white. It scratches glass like a diamond, and cuts it very nearly as easily as the latter, but it will not attack quartz; it gives flashes and sparks of fire when struck smartly in an agate mortar; it is quite devoid of crystallisation, and its fracture is imperfectly conchoidal. No trace of yttria could be obtained from this mineral, but it was found to contain about 1 per cent of glucina as an accidental constituent. It yielded—

Silicic acid .. .. .	90.90
Water .. .. .	4.54
Peroxide of iron and alumina with about 1 per cent of glucina .. }	4.56

100.00

The presence of glucina in this mineral, which is evidently a kind of hydrated silica, menilite, or resinite, is rather interesting, and leads me to believe that this earth will be found in other natural kinds of silica. Silicate of glucina (Phenakite) is so closely allied to quartz in appearance and crystalline form that it is easily mistaken for it, and substances possessing, when crystallised, the same crystalline form are often found together in nature. I do not conclude from the above that the mineral I have examined is identical with M. Damour's silicate of yttria, for I am not aware that I have ever seen the latter. Doubtless he will some day publish an analysis of it.

Analytical Laboratory, Putney, S.W.

## BEET-ROOT SUGAR.

WHEN the Berlin apothecary, Marggraf, in the year 1747, made known, at a meeting of the Royal Prussian Academy of Sciences, the fact that the beet-root contained sugar identical with that derived from sugar-cane, and that he had obtained, by means of alcohol, 6.2 per cent of sugar from the white variety of beet, and 4.5 per cent from the red-coloured root, he certainly did not dream that, within a century after his discovery, the manufacture of beet-root sugar would have become one of the most extensive of what is very properly termed, in the German language, *landwirthschaftliche Gewerbe*, but for which no very

good translation can be given. It is too much the fashion to take it for granted that manufacturing industry ought to be chiefly confined to larger centres of population; but this notion is not entertained on the Continent, where, beside beet-root sugar making, the preparation of madder and various derivatives therefrom is conducted in the country, rather than in towns. This is also the case with the distillation of spirits from wine, as well as that obtained from various other sources—viz., potatoes, beet-roots, cherries, &c.

The proposals made by M. Marggraf to obtain sugar from beet-roots on the large scale did not then meet with any success, owing to a variety of concurrent causes, among which may be mentioned the cheapness of cane-sugar, imported into Germany from this country and Holland. About the end of last century, Messrs. Achard and Hermbstädt again called attention to this subject, and succeeded on a sufficiently large scale in obtaining from beet-roots about 6 per cent of crystallised sugar and 4 per cent of molasses. It was, however, mainly due to the political disturbances and wars of the latter end of the last and the first fifteen years of the present century that the manufacture of beet-root sugar was entered into commercially. This was principally due to the encouragement of Napoleon I., aided by the eminent judgment and sound scientific knowledge of one of his ministers—the famous Chaptal. It is true that, almost immediately after Napoleon's fall, the beet-root sugar industry collapsed—but only to be revived on sounder scientific and mercantile principles, its temporary collapse being partly due to the protective tariffs made in favour of colonial sugars; whilst, in some countries, beet-root sugar making was practically prohibited, also, by absurd and injudicious excise regulations.

The plant known as *Beta maritima* (an unsightly bi-annual vegetable, which grows wild on the coast of the Mediterranean in Spain, Dalmatia, and some parts of France) is the mother plant from which the sugar-yielding beet has been derived. The well-known red beet is a different variety of the same genus. The beet has been an object of regular cultivation as a suitable cattle-fodder only from the beginning of this century, since which time several varieties have been obtained, partly as a result of cultivation, partly, also, as a consequence of climate and soil. The *Beta cicla*, or so-called white Silesian beet-root, is considered by many as the best variety for the production of sugar. This root, as well as the other varieties, is a biannual plant. The first year after sowing it only produces rootlets and leaves; in the second year of its growth, the root becomes developed; and, were it not that this vegetable cannot very well stand frost, the best period for its gathering would be in the spring following its second winter. This condition, however, cannot be complied with, and the crop is gathered in the autumn. The weight of the crop of roots gathered from one hectare varies, as might be expected, considerably; but the following figures may give some idea of this subject:—In Austria, from 416 to 580 cwts., yielding from 3080 to 4336 lbs. of sugar; Bohemia, from 448 to 580 cwts., yielding from 3344 to 4640 lbs. of sugar; Prussia, about 720 cwts., yielding about 5344 lbs. of sugar; France, 596 cwts., yielding 4464 lbs. of sugar. The composition of a good kind of the *Beta cicla*, in 100 parts, is:—Water, 83.5; sugar, with a trace of dextrine (about 0.1), 10.5; ligneous fibre, 0.8; albumen, casein, and other albumenoid substances, 1.5; fatty matter, 0.1; organic substances—viz., pectine, citric, and pectic acids, a substance which, in contact with air, assumes a rose colour, asparagin, oxalates and pectinates of lime, potassa, and soda; inorganic salts—viz., nitrate and sulphate of potassa, chloride of potassium, phosphate of lime, and magnesia, all together, 3.7 per cent. It is evident that the juice obtained from a plant of that complex composition is a somewhat difficult fluid to deal with for obtaining sugar therefrom; and, in order fully to illustrate the triumph of well-applied science in this respect, we quote, for compari-



son's sake, the percentage composition of sugar-cane:—Sugar, 17.8; water, 72.0; cellulose, 9.8; saline matter, 0.4.

There are various processes in use for obtaining sugar from beet-root; but the following is an outline of the general mode of operating:—The roots are dug up, and the head bearing the leaves (which serve together as fodder) is cut off commonly on the field. The roots are then carted to the sugar works, and there washed by machinery, it being essential that neither clay nor pebbles should remain adhering, since these might injure the machinery by which the roots are next made into pulp, by being torn up by very sharp circular saws, placed close together on a revolving cylinder, making from 1000 to 1200 revolutions per minute. The pulp is placed in bags made of a very strong linen tissue, and from twenty-five to fifty of these bags are placed on each other on the movable plate of a hydraulic press, care being taken to place between every two bags a frame wicker-work or perforated tinned-iron plates. The pressure which can be applied averages from 500 to 700 lbs. per square inch; generally the pressing process is repeated, sometimes with, sometimes without previous moistening of the cake, which, in some cases, is also broken up again. Before we follow the juice obtained by this pressure, we may pay a moment's attention to the cake obtained after it has been submitted to repeated pressure. It exhibits a hard, somewhat plank-like appearance, varying in size with the size of the press-plate, and about  $\frac{1}{2}$  or  $\frac{3}{8}$  of an inch thickness. It contains, according to an analysis made at Hohenheim\*:—Water, 15.61; ash, 1.27; cellulose, 1.47; sugar, 1.72; carbohydrates (starch, &c.), 2.84; proteine compounds, 0.28; together, 23.2. To which add, to make up the 100 parts of beet-root, 76.8 per cent of juice, containing:—Water, 65.95; sugar, 10.17; carbohydrates, 0.63; proteine compounds, 0.58. The cake is used as fodder for cattle, or, in some cases, for the manufacture of brandy, vinegar, and, last, but not least, for the manufacture of paper, for which it is increasingly in demand.

The juice, as it runs from the press-plate, is led, by means of gutters, to what is termed a *monte-jus*, and by its means (by steam) forced up to the defecation-pan, wherein it is rapidly heated, by means of steam (the pan being jacketed), to 85°. This temperature having been reached, a thin milk of lime is added, and the fluid thoroughly stirred up. The lime saturates the free acid present in the juice, and precipitates as well as decomposes the albuminous substances, ammonia being consequently evolved. In order that the lime should act properly, it is necessary to increase the heat, which is raised to near the boiling point of the fluid. The quantity of lime added depends upon the quality of the roots, but is generally about from 1 to 2 lbs. for every 100 litres of juice. The liquor in the defecation-pan is run off clear from the supernatant scum, by means of an ingeniously-contrived tap, and, previous to reaching the animal-charcoal filters, the fluid is filtered through a peculiar kind of flannel, made on purpose. The defecated juice is not a pure solution of sugar; it contains saccharate of lime, free sugar, free potassa, soda, and some ammonia; small quantities of organic nitrogenous substances, and sulphate and nitrate of potassa. The removal of a portion of these impurities is effected, in many instances, by filtration through animal charcoal, next submitted to the action of a current of carbonic acid, whereby the saccharate of lime is decomposed; and the clear liquid is evaporated to a density of 24° to 25° Beaumé (sp. gr., 1.199 to 1.210), and again filtered over animal charcoal, in order to remove from the liquid (technically, *clearsel*) colouring matter and other impurities. The filtered juice should have the colour of pale sherry, and be free from any suspended

impurities. The filtered liquor is next evaporated to a density of about 42° Beaumé (sp. gr., 1.412). This evaporation is best performed in a vacuum-pan. When the proper degree of concentration has been attained, the thickish magma (a mixture of crystallised sugar and syrup or molasses) is run into a copper pan, technically termed a cooler; but this is in so far a misnomer, as the contents of the pan are heated by steam to a higher temperature (above 120°) than was attained in the vacuum-pan. The contents of the pan are kept in constant motion, by means of stirring, while a gang of men are busy carrying the pasty mass to the sugar-loaf forms, in order therein to solidify, and to be deprived of adhering syrup by being washed with a solution of pure sugar, sufficiently concentrated for it not to dissolve any crystallisable sugar, while effectually removing the molasses. Instead of this rather expensive process, which yields refined sugar, it is often omitted, and in its stead is substituted the use of the centrifugal machine, or, also, of the so-called Schutzenbach boxes (iron tanks, with a false bottom made of wire-gauze, upon which the magma, after it has been heated in the coolers, is run), and there left for several days, until the molasses have entirely run off; the produce being raw beet-root sugar, which is not fit for consumption until it has been refined, even if its colour is only pale yellow.

The molasses from beet-root sugar are unfit for use as sweetenings, owing to the large quantity of mineral salts they contain. According to Meitzendorf, these molasses consist, in 100 parts, of:—Water, 10.8; mineral salts, 10.5; proteine compounds, 9.8; sugar (cane-sugar and non-crystallisable sugar), pectin, fatty matter, caramel, and other undetermined organic substances, 68.9. This material is employed for the manufacture of spirits, which, however, are not at all agreeable to the palate, but might be rendered pure by re-distillation with quicklime and the use of freshly-ignited wood-charcoal. The residue of this distillation is a valuable source of potash. In Russia and some parts of Silesia, the molasses are used, along with other fodder, for the cattle—a practice which deserves encouragement.

The Continent of Europe contains 1184 beet-root sugar works situated in Germany, France, Russia (inclusive of Poland), Austria, and Belgium. There are, perhaps, scattered over the rest of Europe, some dozen of these works yet; but their production does not materially add to the 4,475,000 cwts. of beet-root sugar annually produced by the works above named. It is evident that, in countries where labour is cheap, and whose inhabitants, but for the beet-root, would be dependent for their supply of sugar upon countries which possess colonies, or dependencies where sugar-cane can be grown, the cultivation of beet-roots intended for the manufacture of sugar is a decided boon. In some cases, objection may be raised to this industry, since it cannot be denied the extensive culture of such crops as, for instance, beet-root, tobacco, madder, &c., may interfere, to some extent, with the cultivation of cereals. Yet, however cogent this objection (which has, also, been several times brought forward against the extensive cultivation of sugar-cane in hot climates), it is an undeniable fact that the rural populations in Europe derive great benefit from this industry, which keeps them suitably employed during the winter months of each year; and the results obtained fully prove that beet-root sugar can hold its ground, and compete successfully with colonial sugar when placed on equality therewith.

As regards the United Kingdom, it cannot but cause some astonishment, that a country ranking first in agriculture, and doubly so in everything relating to manufacturing industry, should have hitherto lagged behind in the successful carrying out of this industry—a fact the more to be wondered at since the cultivation of root crops is very extensively carried on, and the beet-root residues may serve as food for cattle even better than the roots purposely cultivated for that purpose. Agricultural labourers can (as instanced by Continental experience) be readily taught the operations of the beet-sugar manufacture; and the skilled

\* This place is situated near Stüttgart, in Wurtemberg, and is one of the largest and the best conducted agricultural colleges in Europe. It is fitted up, not only for theoretical, but also for practical, instruction, and contains a model beet-root sugar work, brewery, distillery, and other manufactories belonging to the class termed, in Germany, *Landwirthschaftliche Gewerbe*, on a sufficiently large scale for practical use.



supervision does not require more than, at the utmost, half-a-dozen men. In France, Belgium, and Germany, women, as well as men, are employed in these works. As to climate, excepting the central and northern parts of Scotland, and the high moor grounds, the United Kingdom is as favourably situated for the cultivation of beet-root for sugar manufacture as any portion of the European Continent; while the higher standard of agricultural efficiency in this country would greatly tend to secure good crops with existing system of rotation. As regards the duty on sugar, this is now equalised with that payable in the neighbouring countries—France, Belgium, and the Netherlands. So that, if this matter were to be properly taken up, and economically carried out, with due foresight, and there were brought to bear upon it that practical scientific knowledge which has raised, on the Continent, this industry from a puny infancy to the full strength of vigorous manhood, there is no doubt that it may become a source of great improvement and well-being to the rural population of this country.

## ON THE MANUFACTURE OF CRUCIBLE STEEL.

By R. H. SMITH, F.C.S., &c.

A GREAT deal is being talked about the production of cast-steel directly from iron ores, or its manufacture from inferior kinds of English iron; but little is known or said (outside the immediate manufacturing districts) as to how the immense quantities of this substance are produced at the present time. The conversion of iron into steel is, perhaps, to be classed among one of the most peculiar, but, at the same time, interesting, processes with which chemists are acquainted.

The ordinary converting furnaces are of a conical shape, the bar-iron laying in stone pots, in contact with charcoal; and the heat to which the iron is exposed is regulated according to the purpose for which it may afterwards be required. The time generally occupied in what is termed "conversion" is about three weeks, a week being taken to raise the heat to a sufficient degree, a second to maintain it at the required temperature, and a third to gradually cool the furnace. When cold, the bars are withdrawn, and found to be covered with blisters, and, if broken, possessing a fracture totally different in appearance to that shown by the iron before treated in the manner described. Several tempers, as they are technically called, are produced in one furnace, and much care is necessary in selecting them out for the different requirements of the melter.

Too much care cannot be taken in the melting of steel, as the after work so much depends upon this part of the process. The melting-holes are on a level with the floor of the furnace-room. Each hole has a flue; and some six, twelve, or more, of these form a flat stack. The grate bars at the bottom of each hole are approached by means of a cellar below. The crucibles, or pots, as they are called, made from a mixture of several kinds of clay and a little coke-dust, are formed into shape by means of a plug and flask. The pots are annealed over night, and, when at a dull-red heat in the morning, placed in the holes by means of tongs, each furnace taking two pots.

The bar-steel of the required hardness is now broken up, and the crucible charged by means of an iron funnel. The first heat, as it is called, will take from four to five hours before it is ready to be poured; but this greatly depends on the nature and hardness of the steel. The holes are watched and worked by the puller-out; but the word to draw the pot is given by the melter.

The puller-out now lifts the crucible from the hole with large tongs, and places it upon the floor of the furnace. Its contents are then poured by the melter into a mould,

made of cast-iron in two pieces, covered with a coat of coal-tar soot, and held together by rings and wedges.

Great care is required in pouring, or teaming, the steel, as it is technically called, and skill in judging the proper heat when to cast it. Mild or soft steel should be teemed immediately the pot is withdrawn from the furnace; but hard steel may often remain a few minutes with advantage. Each crucible should last one day, and is used three times, with charges of 50, 45, and 40 lbs. respectively.

All steel above a chisel temper contains 0.90 to 1.00 per cent of carbon. If well melted it will settle down in the mould, leaving a small hole at the top of the ingot. If, however, the molten steel has not remained long enough in the fire, it will pour fiery; and, if the ingot, on cooling, be broken, it will be found to be full of small holes, called honeycombs. Great precaution must also be used in not allowing the metal to remain too long in the fire, as hard steel, when of good quality, will soon scorch, and so render the ingot very brittle.

Well melted steel (say, of a tool temper) may be thus known. The ingot will be of a blue colour, with a smooth and even skin; the fracture of uniform brightness, and the outer edge perhaps slightly scorched.

Another very important operation to which steel is subject is the hammering; and probably more good steel is spoiled in this department than any other. The ingot should be well soaked in the flame of the forge-furnace, and not at once (as is often the case) put into a dead fire—where the heat is what is called "dead," and where no flame surrounds the ingot.

The fineness of the fracture of a bar of finished steel greatly depends upon the heat that the bar is allowed to retain when the finishing-stroke of the hammer is upon it. Coarseness and fineness of grain, as judging the temper or quality of cast-steel, is far over-estimated. It is, to a certain extent, an indication of hardness; but so much depends upon the way the bar has been finished, that it is of little practical value. However, best cast-steel, especially when hard, will show a fracture of a silky nature; and, when soft, will look bright, and shine like glass. Common cast-steel, on the other hand, will lack that brightness which is so characteristic of good steel; it will look dull, and have, so to speak, a leaden appearance about it.

In the working of steel, too much care cannot be bestowed; and, where (as in razor-making) the workman is required to use a steel containing about 1.50 per cent of carbon, the durability of the razor will almost entirely depend upon the heat to which he subjects it while forging it into shape.

A useful "tool-steel" will contain about 1.2 to 1.35 per cent of carbon. Spindle-steel, or large-size turning tools, will work well if containing about 1.15 per cent of carbon. Chisel-steel is a temper much used, will harden at a low heat, and possesses great toughness. Steel of 0.85 to 0.75 per cent of carbon will weld easily, and is adapted for "cold setts," or tools where the principal punishment is on the unhardened part.

In melting, charcoal is largely used when the bar-steel is not of the required hardness. Wolfram and titanium are occasionally used, but with little advantage.

Binoxide of manganese is universally employed. It forms a good flux, and protects the molten-steel from the action of the air.

Spiegeleisen is much used in Sheffield. It is an alloy of iron with manganese and carbon. The following is an analysis of a good spiegeleisen:—

Iron (by difference)	..	..	..	84.78
Manganese	..	..	..	10.21
Carbon	..	..	..	5.01
				100.00

Among the many irons employed in steel-making, none have acquired the reputation that those imported from Sweden have won for themselves, and especially those known as the Dannemora marks.



Such brands as Double Bullet (OO) and hoop L (L) command a high price, and are much used where the best quality steel is required. Second Swedes, such as Wand Crown, Steinbuck, Great S, K6, &c., are good bodied irons, largely employed, and making a very good steel.

Of the commoner marks may be quoted (CW) (SV8)

Spider, and  $\overline{FG}$ ; and, where a high price cannot be obtained for the steel, such brands are recommended, being found to melt and work well. English irons and spring ends are also melted, but make an inferior quality of cast-steel.

The following is an analysis of tool-steel:—

Iron (by difference) .. .. .	88.34
Carbon .. .. .	1.31
Manganese .. .. .	0.12
Silicon .. .. .	0.19
Sulphur .. .. .	0.03
Phosphorus .. .. .	0.01
	<hr/> 100.00

### ON THE TESTING OF MANGANESE ORES.

By BENJAMIN H. PAUL, Ph.D.

THE question raised by Sherer and Rumpf\* as to the practice of representing the value of manganese ores by the amount of binoxide of manganese actually contained in them, or equivalent to the other peroxides of manganese which are sometimes present in such ores, is one that will, no doubt, attract the notice of chemical manufacturers. And the suggestion that the value of manganese ores should be measured by chlorometrical degrees, rather than by the actual percentage of binoxide, has a tendency in the same direction as the resolution† passed by the Association of Alkali Manufacturers, last year, in reference to this subject.

The decision then adopted by the Association would seem to have been based more upon differences found, in practice, to exist between working results and the indications of tests made for determining the percentage of manganese binoxide in sample, rather than upon any probable or ascertained cause of variation in the results obtained by the method of Fresenius and Will. It would seem, also, to indicate a desire on the part of manufacturers that tests of manganese ore should express the amount of binoxide *available* for liberating chlorine, and not the amount *actually* present in the ores. It is in this respect that the iron method has an advantage over the method of Fresenius and Will, since the presence of iron as metal or protoxide in manganese ore would affect its power of liberating chlorine. The result of a test of such manganese ore by the iron method would be correspondingly affected; but that would not be the case if the method of Fresenius and Will were adopted in the testing.

Much of the discrepancy between the results of tests of manganese ore, and many of the disputes that have arisen as to the percentage of these ores, may, in all probability, have been due to the circumstance mentioned above; and, to provide against a recurrence of such differences, it would seem desirable that, in regard to a certain class of manganese ores, some other mode of testing than that of Fresenius and Will should be agreed upon, so that the valuation of those ores may be based upon the available binoxide, and not upon the actual amount.

\* CHEMICAL NEWS, vol. xx., p. 302.

† 'That, as the testing of manganese according to the method of Will and Fresenius is, in the opinion of the meeting, incorrect, and yields uncertain results, it is recommended to members of this Association not to buy by that test.'

That form of the iron process in which chloride of iron is used does not appear to be suitable for this purpose, on account of the possible loss of chlorine which may take place in the operation; but Bunsen's method of dissolving the ore with hydrochloric acid, passing the liberated chlorine into iodide of potassium solution, and determining the iodine liberated, would probably answer the purpose.

However, there is reason to believe that Sherer and Rumpf have overlooked another circumstance which must be considered in regard to the method of Fresenius and Will. With certain limitations, there is little doubt that this method gives results which are uniform, especially if the manganese ore tested in that way is of German origin, or if it resembles the German ore in being soft and readily soluble; but many varieties of manganese ore now in use are not of that kind. The Spanish, Nova Scotian, and Californian ores, for instance, are often excessively hard, and, even when finely powdered, difficult to dissolve thoroughly. In testing such ores by the method of Fresenius and Will, there is, in the first place, a risk of incomplete solution, which would make the result too low. If heat be applied to the apparatus in order to render solution complete, there is, in the second place, a risk of driving off water, which would make the result too high.

In some instances, the differences that have obtained between the results of tests could not be referred to the presence of iron as metal or protoxide in the ores, inasmuch as Fresenius and Will's method, has, in those cases, been used by the several operators, and it is probable that those differences arose from the difficult solubility of the ore. But, however that may be, it seems no longer admissible to use that method for testing manganese ores generally, although there is no reason to doubt the uniformity of its results when applied to the soft kind of ores formerly in use almost exclusively.

For these reasons, and on account of the long time requisite for dissolving manganese ores of this kind, the method of Fresenius and Will is not well adapted for testing them. For some time past, therefore, I have adopted Mohr's method of using a known quantity of a standard solution of oxalic acid, together with excess of sulphuric acid, for dissolving the ore; if necessary boiling until the ore is completely dissolved, and then, by means of a standard solution of permanganate, determining the quantity of oxalic acid remaining undecomposed. This method is very convenient for testing manganese ores, and since it involves only one weighing for each test, the source of error is less than in the method of Fresenius and Will. The results obtained are also very uniform.

This method has also the advantage of giving results which fairly represent the amount of available binoxide in manganese ores; for any iron that may be present as metal or protoxide would consume an equivalent quantity of permanganate solution, and thus apparently reduce the quantity of oxalic acid decomposed by the binoxide to an extent proportionate to the amount of iron existing in the ore. Thus, for instance, if the quantity of oxalic acid decomposed by 100 grains of manganese ore free from iron or protoxide of iron were 109.53 grains the ore would contain 76.5 per cent binoxide and the whole of that would be available. But, if the 100 grains of ore also contained 5.6 grains of metallic iron, or an equivalent of protoxide, the permanganate solution required for peroxidising that iron would represent 6.3 grains of oxalic acid, and the quantity of oxalic acid decomposed by the binoxide would appear so much less than it really was, or 103.23 grains instead of 109.53 grains. Accordingly, the amount of binoxide would be represented as 72.1 per cent, instead of 76.5 per cent; and that would, in fact, be the amount of binoxide available for generating chlorine.

This method of testing recommends itself by its simplicity, and by the fact that the standard solutions of



oxalic acid and permanganate will keep for a long time without alteration of value.

The oxalic acid solution contains 63 grms. in the litre, and 1 c.c. is equivalent to 5 c.c. of the permanganate solution.

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ON THE  
SIMULTANEOUS OCCURRENCE OF A SOLUBLE  
LEAD SALT

AND

FREE SULPHURIC ACID IN SHERRY WINE;

WITH OBSERVATIONS ON THE SOLVENT ACTION OF  
ALCOHOLIC SALINE SOLUTIONS UPON SULPHATE OF LEAD.\*

By Professor F. H. STORER.

SEVERAL years since, I was called upon by a wine-merchant of this city to examine a sample of pale sherry taken from a cask which had been returned to him, on the certificate of a chemist that the wine contained lead. The sample in question was perfectly transparent and clear. There was nothing in the appearance or taste of the wine to indicate the sophistication to which it had really been subjected.

On submitting this sherry to chemical analysis, I found not only that it held in solution a considerable proportion of lead, but also a decided trace of free sulphuric acid, besides an abundance of the same acid combined with some alkaline base. When a portion of the wine was evaporated in contact with slips of paper, the latter soon became crumbly and friable.

Regarded merely from the chemical point of view, without reference to its manifest bearing upon questions of hygiene and jurisprudence, the simultaneous occurrence of a lead salt and of free sulphuric acid in alcoholic solution is a fact sufficiently important to merit close attention. Unfortunately, the small sample of wine given me was completely exhausted in the severe confirmatory tests by which the results above mentioned were controlled, and I have had no opportunity to determine the precise manner in which the lead was held in solution in that particular case. Several conjectures as to the cause of the phenomenon will be discussed below.

That lead compounds should still be employed in the treatment of wine will surprise no one familiar with the tenacity with which traditions are held by successive generations of operatives in many of the chemical arts. According to Taylor,† "litharge was formerly much used to remove the acidity of sour wine and convey a sweet taste. Acetate of lead, or some other vegetable salt of the metal, is in these cases formed; and the use of such wine may be productive of alarming symptoms. Many years since a fatal epidemic colic prevailed in Paris owing to this cause; . . . the adulteration was discovered by Fourcroy, and was immediately suppressed."

Beckmann in his "History of Inventions"‡ dwells at some length on the antiquity and enduring character of the practice of neutralising the acid which spoils wine by means of litharge. According to this author, the practice was forbidden by legal enactment in France as early as 1696, but a hundred years later "the art of improving wine by litharge was taught in England as a method perfectly free from danger."||

The sulphuric acid in the sample of wine examined by me was probably added, with a view of removing the dissolved lead resulting from the previous use of litharge.

It is not unlikely that the addition of the free acid was preceded by that of a solution of sulphate of ammonium.

In seeking for an explanation of the fact that a certain proportion of lead may remain dissolved in wine, even in presence of free sulphuric acid, the following hypotheses suggest themselves:—

1st. It seemed not impossible, in case a mixture of weak alcohol, dilute sulphuric acid, and sulphate of lead was left to itself for a long time, that a part of the lead salt might be changed to sulphovinate of lead and pass into solution. This idea was sufficiently improbable in view of the known facts that dilute alcohol and weak sulphuric acid are unfit for making sulphovinic acid, and that but little, if any, of the acid can be formed even from tolerably concentrated liquids, unless the mixture of alcohol and sulphuric acid be heated artificially. The idea was, nevertheless, put to the test of experiment, as follows:—

100 c.c. of alcohol of 59 per cent, 5 c.c. of oil of vitriol, and a quantity of recently precipitated sulphate of lead were placed in a stoppered bottle, and the mixture was frequently shaken during an interval of three months. The clear liquid was then decanted, diluted with water, and saturated with sulphuretted hydrogen gas. Not the slightest colouration indicative of lead was produced.

100 c.c. of similar alcohol, mixed with sulphuric acid, sulphovinic acid, and sulphate of lead, gave no reaction for lead when tested after the lapse of three months.

2nd. Though the idea seemed highly improbable, it was still possible that the sugar in the wine might in some way exert a solvent action upon sulphate of lead. It was found, however, when 100 c.c. of alcohol of 59 per cent and 5 c.c. of oil of vitriol, together with a quantity of sugar and of precipitated sulphate of lead, were left to themselves for three months, that the clear supernatant liquid held no trace of lead in solution. For that matter, it was found that a mixture of sulphuric acid and much sugar-water was capable of precipitating all the lead even from an aqueous solution of acetate of lead. The filtrate from the sulphate of lead thus precipitated gave absolutely no indication of lead when tested with sulphuretted hydrogen, not even when a considerable quantity of the liquid was evaporated to dryness, incinerated, treated with nitric acid, and again evaporated before applying the reagent.

3rd. The most probable hypothesis of all, however, was, that a certain proportion of lead could be held dissolved in presence of sulphuric acid, even in an alcoholic solution like wine, by the action of various soluble alkaline salts capable of decomposing and of being decomposed by sulphate of lead; for it is a well-known fact that very considerable quantities of sulphate of lead can be held dissolved in water by means of many acetates, citrates, and tartrates, and by various other salts.

To test this idea, the following set of experiments has been carried out at my suggestion by Mr. A. H. Pearson, of Haverhill, a student in the Laboratory of the Massachusetts Institute of Technology.

A considerable quantity of dilute alcohol, of the usual strength of sherry wine (18 per cent) having been prepared, standard solutions of acetate of lead, of sulphuric acid, and of sulphate of ammonium were made by dissolving weighed quantities of these substances in portions of the 18 per cent alcohol. Each of the solutions was made of such strength that 500 c.c. of the liquid contained one-tenth of an equivalent of the salt or acid, reckoned in grammes, on the hydrogen scale.

Alcoholic solutions of several salts of ammonium and of the fixed alkalies were also prepared, as will be described below.

In each experiment, equal quantities of the standard solution of sulphuric acid, or of sulphate of ammonium, and of the saline solution to be tested were mixed in a glass flask, and the standard solution of acetate of lead was made to fall from a burette drop by drop into the mixture until a persistent precipitate of sulphate of lead

\* Communicated by the Author.

† "On Poisons," p. 502 of the London edition.

‡ "Chapter on Adulteration of Wine."

|| William Graham's "Art of Making Wines from Fruit, Flowers, and Herbs." London, sixth edition.



was perceived. The burette was graduated so that two drops from it were equal to one-tenth of a cubic centimetre; and the flask was constantly shaken while the drops of acetate of lead were falling into it.

The results of the experiments are as follows:—

*Acetate of Ammonium* was prepared by neutralising ordinary acetic acid with ammonia-water, and the strong aqueous solution thus obtained was mixed with alcohol. It appeared, however, that this alcoholic solution of the acetate exerted no solvent action upon sulphate of lead, for a permanent precipitate of the latter was produced in the mixture of acetate of ammonium and normal sulphuric acid by the first drop of the standard solution of acetate of lead. The same negative result was obtained in several repetitions of the experiment, even when new portions of dilute alcohol and a second set of the standard solutions were employed.

When, however, the solution of acetate of ammonium was mixed with an equal bulk (10 c.c.) of the standard solution of sulphate of ammonium, instead of the sulphuric acid, a considerable quantity of sulphate of lead was held in solution by it. In two distinct trials, the precipitate formed by dropping acetate of lead into the mixed solution of acetate and sulphate of ammonium continued to re-dissolve until 3 c.c. of the standard solution of acetate of lead had been added to the liquor. These 3 c.c. of the standard solution contained 0.1137 grm. of acetate of lead, corresponding to 0.0909 grm. of sulphate of lead. To hold dissolved 1 part of sulphate of lead in the dilute alcohol charged with sulphate of ammonium, there was consequently required 110 c.c. of a tolerably strong solution of acetate of ammonium.

Still another experiment with sulphuric acid was made, by mixing 10 c.c. of an entirely new preparation of acetate of ammonium with a similar quantity of the standard solution of acetate of lead, and dropping the standard sulphuric acid into the mixture. No persistent precipitate was produced in this case until 5 c.c. of the acid had been added. This quantity of the standard acid contained 0.049 grm. of sulphuric acid, corresponding to 0.1515 grm. of sulphate of lead; hence only 33 parts of the solution of acetate of ammonium were required to dissolve 1 part of sulphate of lead. It is to be observed that the insolubility of tartrate, citrate, and succinate of lead in alcohol prevents the application of this modified form of the experiment in the examples given below. With the exception of the acetates of ammonium and sodium, none of the salts experimented with can be mixed with the acetate of lead and subsequently tested with sulphuric acid or sulphate of ammonium.

*Acetate of Sodium*, whether mixed with the normal sulphuric acid, with sulphate of ammonium, or with acetate of lead, seemed to have no solvent action upon sulphate of lead.

Neither *Oxalate of Ammonium* nor normal *Oxalate of Potassium* exerted any solvent action, either in presence of the sulphuric acid or the sulphate of ammonium.

*Tartrate of Ammonium*.—Normal, crystallised tartrate of ammonium was dissolved in alcohol of 18 per cent, in such proportions that 500 c.c. of the solution contained 1.10th of an equivalent, 18.4 grms. of the salt. Twenty-five c.c. of the solution were mixed with an equal volume of the normal sulphuric acid; and normal acetate of lead was added to the mixture until a permanent precipitate was produced. To effect this result, there was required of the standard solution of acetate of lead 2 c.c., or 0.0758 grm. of the acetate, corresponding to 0.0606 grm. of sulphate of lead. The 25 c.c. of the solution of tartrate of ammonium contained 0.92 grm. of the dry salt. Hence, something more than 15 parts of tartrate of ammonium are required to hold 1 part of sulphate of lead dissolved in diluted alcohol containing free sulphuric acid.

In two other experiments, where the tartrate of ammonium solution was mixed with the sulphate of ammonium, instead of with free sulphuric acid, 3 c.c. of the

acetate of lead solution had to be added before a permanent precipitate could be formed.

That sulphuric acid is a more efficient precipitant of lead in presence of tartaric acid than sulphate of ammonium was shown in another way. Thirty c.c. of the standard alcoholic acetate of lead were mixed with an equal volume of the standard solution of tartrate of ammonium. The precipitated tartrate of lead was filtered, and the filtrate mixed with a quantity of the sulphate of ammonium solution. No precipitate was produced, though, on the subsequent addition of sulphuretted hydrogen, a slight precipitate of sulphide of lead was formed. In a similar experiment, where sulphuric acid was substituted for sulphate of ammonium, a slight precipitate was produced by the sulphuric acid, and no precipitate could be obtained afterwards with sulphuretted hydrogen.

In two other experiments, where 5 c.c. of the acetate of lead solution were mixed with 30 c.c. of the tartrate of ammonium, no precipitate was produced by sulphate of ammonium in the filtrate from the tartrate of lead, while sulphuric acid gave a slight precipitate as before. In this case, however, sulphuretted hydrogen gave a slight precipitate after sulphuric acid as well as after sulphate of ammonium.

Normal *Tartrate of Potassium*, mixed with the solution of sulphuric acid, exerted no solvent action on sulphate of lead.

*Succinate of Ammonium*, prepared by neutralising a solution of succinic acid with ammonia-water, exerted no solvent action when mixed with the free sulphuric acid; but, when mixed with the solution of sulphate of ammonium, 6 c.c. of the acetate of lead solution were added to the liquor before a permanent precipitate fell.

Normal *Citrate of Ammonium* was prepared by neutralising a weighed equivalent portion of crystallised citric acid with ammonia-water. Ten c.c. of the solution were mixed with an equal volume of the standard sulphuric acid, and the standard solution of acetate of lead was dropped into the mixture in the usual way. No permanent precipitate was formed until 16 c.c. of the lead solution had been added. These 16 c.c. contained 0.6064 grm. of acetate of lead, corresponding to 0.4848 grm. of sulphate of lead. The 10 c.c. of citrate of ammonium solution contained 0.42 grm. of crystallised citric acid. Hence, 1 part of sulphate of lead was held dissolved in the mixture of alcohol and dilute sulphuric acid for every 0.8663 part of citric acid in the liquor.

On repeating the experiment, a precisely similar result was obtained: 16 c.c. of the standard lead solution had to be added to the mixture of alcohol and sulphuric acid before the precipitate ceased to re-dissolve as fast as it formed.

In two other experiments, where, instead of free sulphuric acid, 10 c.c. of the standard solution of sulphate of ammonium were mixed with 10 c.c. of the citrate of ammonium solution, 30 c.c. of the standard lead solution had to be added in each case before any permanent precipitate formed.

*Dicitrate of Ammonium*,  $C_{12}H_6(NH_4)_2O_{14}$ , was prepared in crystals, and 22.6 grms. of the salt were dissolved in 500 c.c. of the 18 per cent alcohol. Twenty-five c.c. of the solution were mixed with an equal volume of the standard sulphuric acid, and the acetate of lead solution was dropped into the mixture in the usual way. After the addition of 8 c.c. of the standard acetate of lead, a permanent precipitate was produced. These 8 c.c. contained 0.3032 grm. of acetate of lead, corresponding to 0.2424 grm. of sulphate of lead. The 25 c.c. of dicitrate of ammonium solution contained 1.13 grms. of the dry salt. Hence, 1 part of sulphate of lead was held dissolved for every 4.6617 parts of the dicitrate.

*Tricitrate of Potassium*.—Twenty-five c.c. of a standard solution of ordinary crystallised citrate of potassium, mixed with an equal volume of the standard sulphuric acid, gave no permanent precipitate until 2 c.c. of the solution of acetate of lead had been added to it.



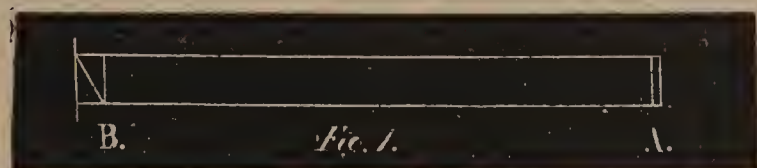
**Sugar.**—A standard solution of cane-sugar, mixed with an equal volume of the sulphuric acid, gave a permanent precipitate on the addition of the first drop of the acetate of lead.

These experiments show clearly that very considerable quantities of sulphate of lead can be held in solution by weak alcohol charged with various salts. It may, therefore, reasonably be inferred that wines sometimes retain lead in solution, in consequence of this action of the acids and salts peculiar to wine upon lead compounds ignorantly employed to correct acidity.

#### NOTE ON THE SUPPOSED POLARISATION OF THE CORONA.\*

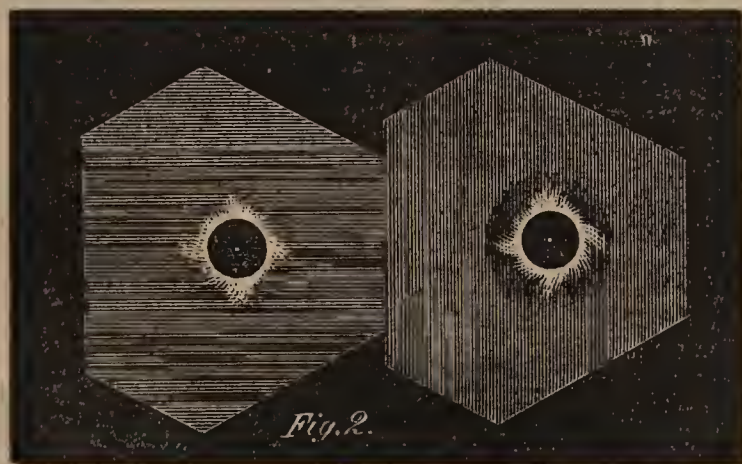
By Prof. E. C. PICKERING.

AN observation on this subject is given in my report in the *CHEMICAL NEWS* (vol. xx., p. 222), but as the form of the instrument used has been in one or two cases misunderstood, I enclose a sketch of it. A, B (Fig. 1) is a sheet-



iron tube, closed at A with a plate of quartz, and at B with a prism of Rochon. The latter has the property of giving two images of any object seen through it, separated by an angle of nearly  $3^\circ$ . Looking through the tube we therefore see two images of the quartz touching, but not overlapping. When the light is polarised, these images assume complementary tints, which vary with the plane of polarisation and the thickness of the quartz. On turning this instrument towards the sun during totality, the images presented the appearance shown in Fig. 2.

The hexagons represent in form and size the plate of quartz; the black circles the moon, here drawn a sixth of



an inch in diameter, as the scale is about  $3^\circ$  to the inch. The corona appeared white, but the sky surrounding it was coloured in one image blue, in the other, yellow,—represented in the figure by vertical and horizontal lines. The conclusion to be drawn from this is, that the light of the corona is unpolarised, or, more strictly, that the amount of polarised light, if any, is too slight to be perceptible with this instrument. Its delicacy, although not equal to Savart's polariscope, is very great, giving coloured images with paper, wood, and other bodies which reflect a small amount of light specularly. The day before the eclipse it showed, in a very marked manner, the polarisation of the wet pavements and roofs. To measure its sensitiveness, I viewed the light reflected by a piece of plate glass, at different angles of incidence, and found that the colour ceased to be visible when this angle was about  $10^\circ$ , which, allowing for the reflection from the second face would give

about one part of polarised to twenty-four of natural light.

Observers heretofore have generally attached their polariscope to a telescope, and thus introduced a source of error, avoided in my instrument. For light passing through the object-glass and field lens would be polarised before reaching the polariscope by the obliquity of the incidence, caused both by the curvature of the surfaces and the fact that the edge of the field of view receives its light not parallel to the axis. The plane of polarisation would be perpendicular to a plane falling through the axis of the instrument. Now, if any part of the corona was brought into the centre of the field of view, the adjoining portions would appear polarised in planes parallel to the edge of the field, or passing through the sun's centre. In sweeping around the sun's edge, the plane of polarisation would continually change, as the corona passed through different parts of the field, and the comparative darkness of the moon's disk and the exterior sky prevent the polarisation of the other portions of the field from being visible. The degree of polarisation by refraction would be very slight and perhaps imperceptible, but the agreement of observation with this hypothesis is certainly a curious coincidence.

The strongest argument against the polarisation of the corona is furnished by the spectroscope, the presence of bright lines and absence of dark ones, as observed by Prof. Young, denoting incandescence, a view strengthened by the consideration that each square centimetre of the surface of the corona would receive several thousand units of heat per minute. I am well aware that my results are at variance with those obtained by previous observers, including some of the most eminent astronomers of the day, but as far as I can learn this form of polariscope has not been used for the purpose, and therefore hope that my experiment may be repeated during the next eclipse.

#### ON MICROSCOPICAL MANIPULATION.\*

By W. T. SUFFOLK, F.R.M.S.

(Continued from p. 9).

THE processes of recording microscopical observations are scarcely less important than those employed in making them. The facts accumulated by the most painstaking observers are of comparatively little use unless means are found of preserving and communicating them to others. This is particularly the case with regard to microscopical studies, and, like most natural-history observations, written descriptions, however graphic, are scarcely intelligible unless accompanied by truthful drawings. The concluding portion of these papers could, therefore, hardly be considered as complete without some mention of the way of writing this language of all nations, a subject which has, with a few exceptions, met with but little attention from writers on the microscope: probably being very expert themselves, the idea prevailed that drawing was as natural an acquirement as writing, and that no special directions were needed. The lectures which supplied the matter for these pages being intended for persons wholly unacquainted with the use of the microscope, it was then deemed advisable to treat upon the subject of microscopical drawing and micrometry at greater length than usual, dwelling especially on those points upon which little information is to be found in books; and the author has seen no reason to alter his opinion

\* Communicated by Prof. Morton, Editor of the *Journal of the Franklin Institute*, to whom we are indebted for copies of the woodcuts.

\* The substance of a course of lectures delivered to the members of the Quekett Microscopical Club, January—April, 1869.



since the delivery of the lectures, but has rather added than withdrawn matter.

*Photography*, from its extreme accuracy and delicate rendering of details, claims a very high place among the resources of microscopical art. When the object is suitable for its employment, the result is not to be equalled by any other means of delineation. The conditions, however, which it is requisite to comply with in order to obtain a successful micro-photograph somewhat limit the cases in which it is available. The object to be photographed should be very thin and flat, so that the whole, or the greater part of it, lies in the same plane, that it may all be in focus at once; the reduction of aperture commonly used by landscape photographers to secure focal depth not being practicable, on account of the great loss of light occasioned by the use of small diaphragms, which is so great when the object is much magnified as to render the production of an impression on the prepared plate impossible with any reasonable amount of exposure. This is a very great drawback, as many of the most interesting microscopical objects can scarcely be seen without continual alteration of the focal adjustments. The colour of the object should also be such as is favourable for photographic purposes; the yellow, brown, and red tints of many tissues render it impossible to obtain any satisfactory result. The best photographs are always those obtained from colourless objects, such as the *Diatomaceæ*, the delicate sculpture on the frustules of which are marvellously rendered, as may be seen by examining the photographs by Dr. Maddox, to be procured of Mr. How, of Foster Lane, at a merely nominal price. So minutely are the details produced that they will, when photographed upon glass, bear a considerable amount of enlargement by means of the magic-lantern.

At present only objects illuminated by transmitted light have yielded impressions on the prepared plate, the more feeble images obtained from reflected light and dark field illumination have failed in producing photographs, and so a large and interesting class of objects is excluded. Possibly future improvements may remove this, and some other difficulties which at present limit the use of this valuable art. The necessity of employing special apparatus and of mastering a delicate set of chemical processes will, it is to be feared, prevent many microscopists from availing themselves of photography as a means of delineating the objects presented to them in the course of their studies.

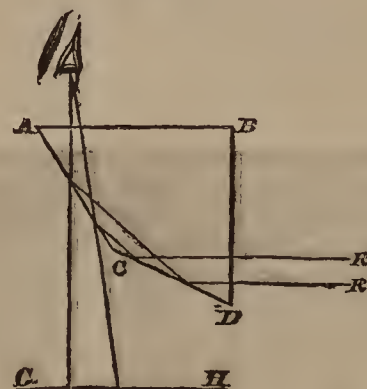
The practical details of manipulation and the bibliography of the subject are treated at considerable length in Dr. Beale's "How to Work with the Microscope," 4th edition, pp. 229 to 279.

Fortunately, the other processes used in making representations of objects are within reach of the majority of microscopists. The apparatus being simple and inexpensive, compared with that needed for obtaining photographs, and the use of it so easily mastered, that, with a little perseverance, most persons will be found able to obtain drawings really useful, although, perhaps, somewhat wanting in finish and delicacy. Even these may be attained in some degree by painstaking application; and, although the student's productions may not equal the work of professional artists, they will be found to possess an amount of truth which would most likely be wanting in the work of a more accomplished but less scientific draughtsman.

The simplest, but not the easiest, method is to make the drawing without instrumental aid. Few but those who are expert draughtsmen can accomplish this. The difficulty of obtaining anything approaching an accurate representation can only be understood by those who are familiar with the process. The chief obstacle is the impossibility of seeing object and drawing nearly together, as in landscape or other sketching, and the consequent trouble occasioned by frequently losing the place, especially during the earlier stages of the outline; the peculiar view afforded of the object depriving the observer of those guides used in ordinary drawing from nature. The impossibility of making the drawing to scale is another disadvantage, and renders it of but little value as a microscopical record. For objects in active motion no other mode is available, and in such cases it is of value, also, for making slight sketches and memoranda during observations, and preserving facts which would otherwise be lost; but where considerable accuracy is needed some one or other of the instrumental appliances now to be described must be employed. Nearly all the instruments attached to the microscope with a view to aid delineation act upon the principle of rendering the image of the object and the paper and pencil-point visible together and apparently blended. This may be accomplished in several ways, although the principle of reflection is used in all cases.

The oldest of these instruments is the *camera lucida* of Dr. Wollaston; it consists of a four-sided glass prism (Fig. 39), of which the angle A, B, D

FIG. 39.



equals  $90^\circ$ , the angles B, A, C, and B, D, C,  $67^\circ 30'$ , and the angle A, C, D,  $135^\circ$ ; it acts by twice reflecting the rays R and R', proceeding from the eye-glass of the microscope, which enter through the side B, D, first at C, D, and afterwards at A, C, to the eye, so placed at A that one-half of the pupil is over the edge of the prism, and views the image of the object in the microscope, the pencil and paper being seen by the other half, which is placed beyond the edge A. As the reflections are internal,\* there is scarcely any loss of light; the image is consequently very bright, and owing to its being twice reflected, it is not inverted when it reaches the eye. The prism is mounted in a convenient setting, so that it may be fitted over the eye-piece in the place of the cap, which is of course removed. A lens is sometimes attached to the lower part of the camera lucida, between the eye and the paper; this is of use to persons who cannot see the drawing distinctly at the usual distance, about ten inches, and may be either convex or concave, according to the special requirement of using it.

\* CHEMICAL NEWS, vol. xx., p. 266.



A small steel disc, known as *Soemmering's mirror*, placed at an angle of  $45^\circ$ , is used by some microscopists. The polished disc is smaller than the pupil of the eye; so that, while the image from the microscope is viewed by the centre of the pupil, its circumference is employed in viewing the paper and pencil-point, upon which the image appears to be projected, as in the camera lucida.

(To be continued.)

## ON ESSENCE OF SASSAFRAS.

By MM. E. GRIMAUX and Y. RUOTHE.

ESSENCE of *Laurus sassafras* is colourless when first rectified, but turns gradually yellow after exposure to air and light. Its smell resembles that of essence of fennel. Its density at zero is 1.0815; it rotates the polarised ray to the right, and its rotatory power is  $3.5^\circ$  for a length of 10 centimetres. It is a mixture of dextrogyrous hydrocarbon with an inactive oxygenated principle, and also contains small quantities of a body which is apparently a phenol, and which gives it the power of reducing nitrate of silver. This body is separated from the essence by stirring with this latter an aqueous solution of potash, which, after the addition of chlorhydric acid, precipitates some oily drops, having a strong smell of eugenic acid, and coloured light green by ferric chloride. By distilling this body with steam, a colourless liquid was obtained in just sufficient quantity to permit analysis, which gave  $C=74.43$ ,  $H=6.46$ . Such extremely small proportions are found in the essence that it can scarcely be said to do more than exist. The hydrocarbide (safrène) contains  $C_{10}H_{16}$ , which formula is confirmed by the density of its vapour, which, ascertained by Dumas's method, was found equal to 4.71 (theoretically, 4.7). Safrène boils between  $155^\circ$  and  $157^\circ$ , is dextrogyrous, and its rotatory power is  $17.5^\circ$  for a length of 10 c.c.; its density at zero is 0.8345.

Nine-tenths of the essence are extracted after the first distillation between  $230^\circ$  and  $236^\circ$ . They consist of an oxygenated principle (safrol), which distils chiefly between  $231^\circ$  and  $233^\circ$ . This latter has not a constant boiling point, for it always changes and becomes slightly resinous under the influence of much heat. It is insoluble in water, but difficult to dry over chloride of calcium, and requires rectification in a current of pure hydrogen before analysis. Its odour is similar to that of the essence; its density 1.1141 at zero; it exerts no influence on polarised light, and remains liquid at a cold as low as  $-20^\circ$ . Safrol will not combine with bisulphites, dissolve sodium, or decompose chloride of benzoyle at its boiling point. It will not dissolve alcoholic potash even at  $180^\circ$ , but is changed by it into a black, non-crystallisable resin.

Treated with boiling iodhydric acid at  $127^\circ$ , it yields a thick green iodised oil; with perchloride of phosphorus it gives only a protochloride, and no trace of oxychloride, and the thick viscous body left in the retort after distilling the protochloride should be a monochloruretted safrol. It does, in fact, present the appearance and qualities of those monobromised derivatives obtained by merely adding a molecule of bromine to a molecule of safrol, but if excess of bromine be added, a solid crystallised derivative of pentabromised safrol,  $C_{10}H_5Br_5O_2$ , is obtained. To prepare this body, dissolve safrol in sulphide of carbon, and add five times its weight of bromine; after a few days the vessel will be found to contain crystals. Dissolve these in chloroform, wash the solution with potash, and concentrate; rectangular and perfectly white flakes of pentabromised safrol,  $C_{10}H_5Br_5O_2$ , will separate.

This body melts at  $169^\circ$  or  $170^\circ$ , is but slightly soluble in alcohol or ether, even at the boiling point, and dissolves

in about fifteen times its weight of chloroform, with simultaneous production of a very small quantity of another bromised derivative melting at  $109^\circ$ . Upon subjecting safrol to the action of sundry other reagents, no satisfactory results were obtained. Nitric acid, even when much diluted, renders it resinous, with production of oxalic acid; it dissolves in the fuming acid, yielding a non-crystallisable derivative, soluble in alkalies at moderate temperature. When heated with chloride of zinc or phosphoric anhydride, it quickly decomposes, leaving much carbon; sulphuric acid produces the same effect. Fusing potash attacks it with difficulty; a distillation of the essence over melting potash modifies its boiling point; that which formerly distilled between  $230^\circ$  or  $234^\circ$ , now comes over between  $245^\circ$  and  $250^\circ$ , and even at from  $247^\circ$  to  $248^\circ$ . The analysis of this body gives the same figures as that of the essence.

## CORRESPONDENCE.

### GMELIN'S CHEMISTRY.

To the Editor of the Chemical News.

SIR.—It is known, no doubt, to all your readers that the Cavendish Society has been for some years defunct, and that their works are understood to have been handed over to their publisher, Mr. Harrison, of 59, Pall Mall. That gentleman has since issued the two last but one volumes of the translation of "Gmelin's System of Chemistry," which, at the demise of the Society, was incomplete. But the last volume (vol. xviii.), which is to contain the index, is not yet published, nor does there appear any certainty when it will be, if ever.

Yet, in the absence of this index volume, this magnificent work is almost useless to chemists for reference. Two or three years having elapsed without any progress towards our attaining this index being apparent, may I enquire whether Messrs. Harrison have any copyright in this work, and if not, suggest that it would, probably, be worth the while of some other publisher to set vigorously about producing the index to Gmelin.—I am, &c.,

REFERENCE.

January 11, 1870.

### SAMPLING OF CARGOES OF PHOSPHATIC RAW MATERIALS.

To the Editor of the Chemical News.

SIR,—It has now become a settled practice to fix the price to be paid per ton according to the percentage of tribasic phosphate of lime found by analysis. Samples are usually sent to two chemists, and, for their convenience, sent in fine powder. The seller or his agent suggests that, to procure this powder, the material should be passed through mill-stones; and some manufacturers are unwise enough to consent to such a vicious practice, which goes far to explain the well-known fact that, given a certain quantity of material stated to contain a certain percentage of phosphate of lime, you can never obtain, in the manufactured article, the amount of phosphate you had right to expect by calculation. In the action produced by the process of grinding, great heat is evolved, which heat proceeds from the moisture which is thus, to a certain extent, used up, and disappears; and thus it is not unfrequently found that 1, 2, or 3 per cent of moisture disappears, and the phosphates, consequently, are increased in the analysis. We have long expected that analytical chemists, who must have been well aware of the injustice, would have come forward and proposed a remedy; but they have not done so; and, lest it may be supposed that it is a necessary evil, and there is no cure, we beg to suggest one or two modes by which the injustice can be removed.



1. While the cargo is being discharged, let one weighing in fifty be placed over a kiln or some convenient drying-place, and thus a great portion of the moisture dried off and ascertained. Most manufactories afford convenient means for accomplishing this, which can be done by the sellers and buyers' agents, and during the discharge of the cargo. Suppose 5 per cent of moisture is thus driven off, then the phosphate found in 95 grs. of such sample will represent that which exists in 100 grs. of the cargo. There will then be no objection to passing the dried sample through stones. This mode is particularly suitable for wet cargoes; but, in a case where this drying cannot be conveniently accomplished,

No. 2 plan may be adopted, which is either to send rough samples to the chemist or, if, for their convenience, a fine sample is wanted, to send a rough sample with it at the same time, from which the chemist should ascertain the moisture. In all cases, as the moisture resides mostly in the fine part of the cargo, it is desirable to pass the sample lot through a screen, and then, by weighing each separately, to ascertain their respective proportions, and then taking care that the sample for analysis should be made up in the same proportion—say one of fine, and and two of rough, as the case may be.

3. There is yet another mode of dealing with the difficulty, and that is for the seller to allow the buyer 1 or 2 per cent, according to the dampness of the cargo, for the privilege and convenience of allowing the whole to be ground under stones.

Here, then, are three methods, each fair to both parties, and vastly preferable, we think, to the unjust system frequently pursued and which often leads to disputes.—We are, &c.,

SPoonER & BAILEY.

## MISCELLANEOUS.

**New Food Journal.**—We perceive with pleasure that Messrs. J. M. Johnson and Sons, of Castle Street, Holborn, announce their intention of bringing out a new and cheap periodical, called the *Food Journal*, to be devoted entirely to the very important subjects of Food and Public Health. These two great questions are so prominent now-a-days, and embrace so many details of personal interest, that we cannot, even on purely selfish grounds, refuse to listen to them, especially when put before us in any other but a professional and technical guise. The adulteration question will be largely and carefully dealt with, and many of the leading sanitary writers of the day will contribute to the pages of the Journal.

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

*Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

*Comptes Rendus des Séances de l'Académie des Sciences*, December 27, 1869.

This number opens with an eulogium on—

**The Annuaire du Bureau des Longitudes for 1870.**—M. H. St. Claire-Deville.—The speaker observes that this very useful periodical has, in consequence of its various and comprehensive scientific data and memoranda, become indispensable to the scientific chemist; and the well-known *savant* desires to see its use greatly extended. As is known (at least, to some of our readers), the periodical alluded to owes its origin to the eminent men who were foremost among the authors of the first French Republic, and who founded the Ecole Polytechnique.

**Acclimatisation of the Cinchona Trees in the Island of Réunion.**—M. Morin.—The author, encouraged by the success obtained in the British and Netherlands' Colonies, has induced a friend

residing in the above-named island, a French possession, to try the acclimatisation of this important tree; and the result is such as to foster the reasonable expectation that the Island of Réunion will, within a few years, also become a *Cortex*-producing country.

**Presence of Soda and Potassa in Divers Parts of Plants.**—M. Pierre.—In reply to some objections made by M. Peligot to the author's statements on this subject, he says—I admit the presence of a small quantity of soda as a normal constituent of plants, but its quantity decreases permanently, whereas the quantity of potassa increases constantly during the life of plants. The increase of the latter base follows the same rule as the increase of phosphorus, nitrogen, &c.; and while potassa is combined in a manner which renders it a very fixed mineral, soda is easily removed by a simple treatment with distilled water.

**Artificial Production of some Precious Stones.**—M. Gaudin.—While presenting to the Museum of the Academy an exquisite collection of artificially-prepared precious stones, the author communicates some curious observations on the effect of a powerful oxyhydrogen blowpipe blast. Alumina, by itself, cannot serve for obtaining precious stones, owing to the tendency of this earth to devitrify again. It does not become pasty before fusing, but liquefies at once, and is as fluid as water; and next volatilises as if it were camphor. In order to render alumina viscous, quartz has to be added; but that impairs the crystallisation, and also the hardness. The colouration of the stones is another difficulty, since the enormously high temperature of the oxyhydrogen blast acts upon several substances, such as compounds of gold, silver, palladium, and other metals, in a manner quite different from that of a furnace fire. Copper is a protean substance in this aspect, and, by dexterous manipulations, may be used to produce many tints of colour. Curiously enough, manganese and nickel yield, at this high temperature, an orange-yellow colouration; and chromium, exposed to the reducing flame, gives a sky-blue, and in the oxidising flame, a deep green, which is smoked (*enfumé*), as it were, and has not even a remote resemblance to emerald green. This colour can only be obtained by a special and very well directed oxidising manipulation from oxide of copper.

**Rendering Commercial Sulphide of Carbon Inodorous.**—M. Cloëz.—The author states that, when sulphide of carbon is left for twenty-four hours in contact with half per cent of its weight of finely-powdered corrosive sublimate, care being taken to shake or stir up this mixture, the mercurial compound combines with the substances which are the cause of the fetid odour of this substance, and an insoluble compound is deposited. The liquid is carefully decanted, and, after 0.02 of its weight of a pure inodorous fat has been added (no reason is given for this addition), the sulphide is re-distilled with care by the heat of a water-bath. The sulphide thus obtained exhibits an ethereal odour, and is eminently suitable for the extraction of oils, fats, &c., from various substances, since, on evaporation of the purified sulphide, these matters are obtained in as fresh and pure a state as if the oils had been obtained by pressure.

**Chemistry of Copper.**—Dr. Sterry Hunt.—The author has instituted a comparative research on protochloride of copper,  $\text{Cu}_2\text{Cl}$ , and chloride of silver. The properties of these salts agree in so many aspects, according to the author, that he feels inclined to place these metals, copper and silver, in the same class.

**General Researches on the Modifications which Minerals Undergo when Submitted to the Action of Saline Solutions.**—M. Terreil.—The author describes, at great length, in this paper, the action of a solution of monosulphide of sodium (1 part of dry salt in 10 of water) upon a great number of metallic sulphides, selenides, tellurides, and antimoniosulphides; the conclusion arrived at is that monosulphide of sodium may advantageously be applied, not only for the separation, but even the quantitative determination of some metals existing in minerals in the state of sulphides.

**Preparation and Properties of Hydrate of Chloral.**—M. Personne.—Referring to the labours of MM. Roussin and Dumas on this subject, the author, after repeating, with great care, the experiments of the last-named eminent *savant*, concludes that the substance obtained by M. Roussin (a sample of which, given by the latter to the author, had been analysed by him) is not pure hydrate of chloral, but a trichlorinated acetate, of the formula  $\text{C}_4\text{HCl}_3\text{O}_2$ . The author also observes that, whereas 100 parts of absolute alcohol yielded, by M. Roussin's mode of preparation, only 80 per cent of substance, he, on following exactly M. Dumas's method, obtained 185 per cent of a real and pure hydrate of chloral.

**Separation of Ordinary from Inverted Sugar.**—M. Dubrunfaut.—The author, continuing his altercations and discussions with M. Maumené on this matter, describes in this paper, at great length, his experiments of separating, by means of lime, ordinary sugar from inverted sugar.

**Simultaneous Action of the Intra-Pilair Current and Nascent Hydrogen upon Organic Acids.**—M. Royer.—Under the influence of nascent hydrogen and *intra-pilair* action, the author has converted oxalic acid into formic acid.

**Metamorphosis and Migrations of the Immediate Principles in Herbaceous Plants.**—M. Dehérain.—This lengthy memoir contains the records of an interesting series of researches proving the curious changes which substances—as, for instance, sugar, albumen, gum, &c.—undergo in the living plants, and especially in the cereals.

**Detection of Cyanhydric Acid and Cyanides in Cases of Poisoning.**—M. Bonjean.—A foot-note added to this title of a paper, and signed "D.," informs the reader that this paper could not be printed for want of sufficient experimental details.

**Heavy Flint-Glass for Optical Purposes.**—M. Feil.—This gentleman sends in samples of perfectly homogeneous glass free from



any bubbles or defects, and in masses weighing from 25 to 35 kilos. The process whereby this is obtained is not explained; but the statement is made that the crucibles having been protected from the effects of the lead, a heavier glass even than Faraday's can be made. The maker sends, also, a set of samples of beautifully-made artificial precious stones, not mere specks, but of good size. The mode of manufacture applied to these gems will, according to the author's statement, give interesting results for the study of some optical phenomena. The aluminates of lime, of baryta and lime, of lead and of bismuth, are proposed for flint-glass; and the aluminates of magnesia and the silicates of magnesia and alumina for crown-glass.

*Berichte der Deutschen Chemischen Gesellschaft zu Berlin*, No. 18, 1869.

At the ordinary meeting of this Society, held on the 22nd of November last, under the presidency of Dr. A. W. Hofmann, the following papers were read:—

**Lecture Experiment to Show the Increase of Weight Caused by Combustion.**—Dr. Kolbe.—Since the value of this paper rests entirely upon the woodcut annexed to it, describing the very ingenious apparatus contrived by the author, we only mention the title.

**Carbonate of Phenol.**—M. Kempf.—When three parts of phenol and two of fluid phosgen are heated to about 150°, and the contents of the tube afterwards treated with a dilute solution of caustic soda, a solid substance is obtained which crystallises from its alcoholic solution in white silky-looking needle-shaped crystals. The formula of this substance is  $C_{13}H_{10}O_3$ ; it is insoluble in water, readily soluble in alcohol and ether, fuses at 78°, and can be sublimed. When treated with concentrated caustic soda solution, it yields carbonate of soda and phenyloxid-soda; its formula, as carbonate of phenol, is  $(C_6H_5)_2O_2(CO)$ .

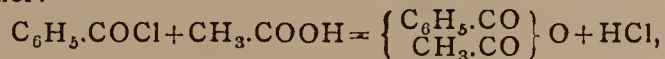
**Action of Chloro-Chromic Acid (Chromsäure-chlorid) upon the Aromatic Hydrocarbons.**—M. Carstenjen.—Chloro-chromic acid,  $CrO_2Cl_2$ , acts, when pure, with so great violence upon most organic substances, that deflagration ensues. The author has found that glacial acetic acid is the best diluent, and with such a solution he has investigated its action upon the following substances:—*Benzol*. \* *Naphthalin* yields a compound,  $C_{10}H_4Cl_2O_2$ , fusing at 188°, and soluble only in boiling alcohol; it is a bichloronaphthochinon, and is derived from naphthalin according to the following formula:—



*Anthracen* yields bichloronaphthochinon and anthrachinon, free from chlorine; formula,  $C_{14}H_8O_2$ . *Toluol* yields benzoic acid and rather complex results, which are formulated thus:—



The  $C_6H_5.COCl$  acts further upon the glacial acetic acid, in the following manner:—



and the mixture of *anhydrous acids* yields, with  $H_2O$ , benzoic acid and acetic acid. With xylol, the final result of the reaction is an acid—a solid substance fusing at 173°, and of the composition of toluyllic acid—and besides, also, terephthalic acid. Pure mesitylen prepared from acetone is almost insoluble in glacial acetic acid; the action of chloro-chromic acid is consequently very violent, and great caution is required in managing this experiment. The result is the formation of mesitylenic acid.

**Contribution to the History of the Sulphocyanides of the Alcohol Radicals.**—M. Henry.—This paper is divided into the following sections:—Action of iodide of cyanogen upon mercurio-mercaptan,  $(C_2H_5)_2HgS_2$ ; trisulphocyanallyl,  $C_3H_5(CNS)_3$ ; sulpho-cyanide of benzyl, or methyl-benzol,  $C_6H_5-CH_2CNS$ ; nitro-sulphocyanide of benzyl,  $C_7H_6(NO_2)CNS$ .

**Direct Combination of Chloride of Phosphorus ( $PCl_3$ ) with Sulphur.**—M. Henry.—The author says—Dr. Odling states, in his excellent "Manual of Chemistry" (vol. i., p. 287), that oxygen and chloride of phosphorus combine directly at the boiling-point of the chloride. Acting upon this hint, the author tried whether sulphur would act in the same manner, and yield  $PSCl_3$ . Very pure chloride of phosphorus, boiling at 78°, was heated to 130°, along with pulverised sulphur, in a sealed tube; the sulphur disappeared. On being submitted to distillation, the fluid came all over at 120°, and the distillate, a colourless fluid exhibiting a sharp smell, proved to be the compound  $PSCl_3$ .

**Wax of Corn-Straw.**—M. Radziszewski.—After referring to the researches on the subject of the wax of the *Gramineæ*, made by Dr. G. J. Mulder, M. Dumas, and others, the author states that he has found a waxy substance in the straw of the corn species. This substance is insoluble in water and solutions of caustic alkalis; soluble in boiling alcohol, ether, and sulphide of carbon; fuses at 42°; boils, without decomposition, at 300°; and sublimates at 303. This substance has, therefore, some analogy with the *cérosie* from sugar-cane. The author states that the sample investigated by him was given him by M. Naeyer, paper manufacturer, at Willebroeck lez Malines, Belgium, who appears to have first obtained this material while converting straw into pulp.

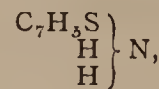
**On Mercurodiphenyl.**—M. Otto.—The author refers back to a paper on this subject by him and M. Dreher (see *CHEMICAL NEWS*,

\* The author's paper on this subject, in the *Journal für Praktische Chemie*, No. 14, 1869, having been abstracted by us, we pass this portion over in silence.

vol. xx., p. 285), and explains, in this present paper, his views, dissenting from some statements made by his co-partner. The paper is not suited for abstraction.

**Hydrate of Bromal, and its Action upon the Animal Organism.**—M. Steinauer.—The author prepares the hydrate of bromal by causing a current of carbonic acid, saturated with vapours of bromine, to pass into alcohol. The hydrate of bromal thus obtained in large crystals was purified by re-crystallisation, and then used for experimenting with upon animals.

**Action of Iodide on Thiobenzamide.**—Dr. Hofmann.—When, to a cold saturated alcoholic solution of this benzamide—



an alcoholic solution of iodine is added, the latter soon becomes de-coloured, and sulphur is precipitated; when iodine is added in slight excess, the liquid, after having been decanted from the free sulphur it contains suspended, becomes a thick magma on the addition of water. By washing with the latter, the hydriodic acid is removed; and by resolution and repeated re-crystallisation from boiling alcohol, a solid snow-white substance is obtained, fusing at 90°, and subliming, without decomposition, at a high temperature; this substance is also soluble in ether, chloroform, and benzol, and the author considered he had to deal with a compound freed from sulphur, since even delicate tests failed to indicate its presence. When, however, the vapour of this substance is passed over a red-hot mixture of pure nitrate of potassa and carbonate of soda the presence of sulphur is ascertained without difficulty. Elementary organic analysis of this substance led to the formula  $C_{14}H_{10}N_2S$ , and its formation is expressed by the following equation:—

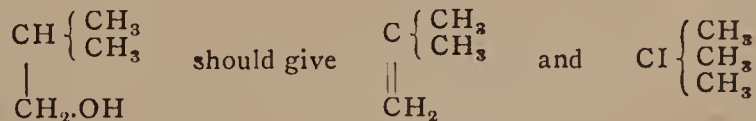


Chlorine, bromine, and moderately-dilute nitric acid act in the same manner upon thiobenzamide. The author states that the new compound just alluded to exhibits a most remarkable stability, and a stolid insensibility against the action of even rather strong reagents and rough treatment. Acids, even at boiling-point and in sealed tubes, do not affect this material, and the action of alkalis is very gradual and slow; by hydrogen, *in statu nascendi*, it is converted into a base, the hydrochlorate of which is formulated by  $C_{14}H_{14}N_2.HCl$ ; and the composition of the platinum salt is  $2(C_{14}H_{14}N_2.HCl)PtCl_4$ .

Under the title of "Correspondence," this number contains:—

**Review of the Labours of the Chemistry Section of the Late Meeting of German Physicists and Natural Philosophers at Insprück.**—Dr. Gunning read an interesting paper on the use of perchloride of iron for the purification of potable waters.—Prof. Barth spoke on the isomeric modifications of toluolsulpho acid and its decomposition by fusing caustic potassa. The chief point of interest, as regards this matter, is that the author has succeeded in obtaining, from crude toluolsulpho acid, certainly two, and probably three, quite distinct modifications, as exhibited by the difference of the potassa salts of the same.—Prof. Kekulé spoke on the constitution of salts.—Dr. Marquart called attention to the action of perfectly neutral solutions of nitrate of strontia upon wrought-iron vessels used to evaporate that liquid, the consequence of which is the cracking and tearing-up of the metal.—Dr. Batka read a paper on tea, and called attention to the great discrepancies of the analysis of that substance. In the discussion which followed, Prof. Hlasiwetz observed that the quantities of the general principles of plants vary to such an extent, and are so dependent upon the conditions under which plants are grown, that the quantitative estimations thereof are of very little value.

The St. Petersburg correspondent writes—"At the meeting of the Chemical Society held on the 6th of November, O.S. (1869), M. Morokownikoff stated—When any alcohol gives off the elements of water, or when its haloid anhydride gives off a haloid hydrogen, there is simultaneously given off one atom of hydrogen, which is combined with an atom of carbon. By direct addition to unsymmetrically-constituted hydrocarbons,  $C_nH_{2n}$ , of the elements of  $H_2O$  and  $HX$ , the latter are so divided that the hydroxyl or haloid combines with that atom of carbon with which the smallest number of hydrogen atoms are combined. According to this view, normal butyl-alcohol ought to yield a butylen,  $CH_3-CH_2-CH=CH_2$ , and with  $HI$ , the iodanhydride of the secondary pseudo-butylalcohol of Luynes; and the isobutylalcohol must yield the tertiary butylalcohol of Butlerow—

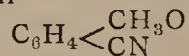


The Experimental researches on this subject, instituted with the isobutylalcohol of fermentation, fully proved the correctness of these views, which are confirmed by M. Butlerow, who has been experimenting in the same direction. M. Gustavson stated that, while heating boracic acid with pentachloride of phosphorus in sealed tubes to 140°, chloride of boron,  $BoCl_3$ , is readily obtained. Upon causing nitric acid to act upon acetoluide, MM. Beilstein and Kuhlberg have obtained mono- and dinitro-acetoluide. The former yields, with caustic potassa, orthonitrotoluidine; this substance differs from the paranitrotoluidine (as obtained from dinitrotoluidine) by its fusing-point, 114°, and by not being capable of combining with acids. M. Wroblewsky has prepared, from chlorotoluol boiling at 156°—160°, a nitro-chlorotoluol boiling at between 242° and 255°; by repeated fractional distillation, he obtained two isomeric substances— $\alpha$ , boiling at 243°, sp. gr. 1.307 at 18°; and  $\beta$ , boiling-point 253°, sp. gr. 1.3259 at 18°.—MM. Engelhardt and Latschinow communicated researches made by them on toluolsulpho-potassa and the potassium-salts of xylol-sulpho acid.—M. Maikopara communicated his researches on  $\alpha$  and  $\beta$

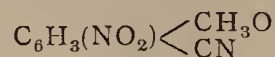


naphthalin-sulpho acids and the chloranhydride, amide, and mercaptan of that series.—M. Mendelejeff read a lengthy paper on specific heat, and his researches on this subject.—This ends the correspondence.

Researches on the Ethereal Derivatives of the Polyvalent (Mehrwerthigen) Acids and Alcohols.—M. Henry.—This lengthy paper, a continuation of a former on the same subject, contains the following sections:—Aniso-derivatives; anisaldehyde; aniso-nitril, or methyl-paroxybenzoyl-nitril—



nitro-aniso-nitrile—



New Series of Double Chlorides belonging to the Platinum Bases.—M. Thomsen.—This paper is too much filled with formulæ to be fit for any useful abstraction.

Synthesis of Hydroxylamine.—MM. Ludwig and Hein.

Strychnine an Antidote against Poisoning with Chloral.—M. Liebreich.

Critical Remarks upon M. Otto's Paper on Mercurodiphenyl.—M. Dreher.

*Zeitschrift für Chemie von Beilstein*, No. 23, 1869.

This number contains the following original papers:—

Derivatives of Naphthalin.—MM. Faust and Saame.—The authors have prepared and fully investigated the chlorinated substitution products of naphthalin. They describe A, what they call addition products, viz.:—Naphthalintetrachloride,  $\text{C}_{10}\text{H}_8\text{Cl}_4$ , a solid substance fusing at  $182^\circ$ , and crystallising from its chloroformic solution in large rhombohedral crystals; monochloronaphthalintetrachloride,  $\text{C}_{10}\text{H}_7\text{Cl}_5$ , also a solid substance crystallising in klinorhombic prisms, and fusing at about  $129^\circ$ ; dichloronaphthalintetrachloride,  $\text{C}_{10}\text{H}_6\text{Cl}_6$ , again a solid substance, crystallising in klinorhombic prisms, and fusing at  $172^\circ$ . All these substances are devoid of smell, difficultly soluble in alcohol, more readily soluble in ether and ligroine; their best solvent is chloroform. B, substitution products:—Monochloronaphthalin,  $\text{C}_{10}\text{H}_7\text{Cl}$ , a colourless oily fluid, boiling at  $250^\circ$ ; monochlorodinitronaphthalin,  $\text{C}_{10}\text{H}_5\text{Cl}(\text{NO}_2)_2$ , a yellow-coloured solid, crystallising in needle-shaped crystals, and fusing at about  $104^\circ$ ;  $\alpha$  dichloronaphthalin,  $\text{C}_{10}\text{H}_6\text{Cl}_2$ , a fluid, boiling at about  $280^\circ$ ;  $\alpha$  tetrachlorotribromodinitronaphthalin,  $\text{C}_{20}\text{H}_9\text{Cl}_4\text{Br}_3$ , a solid substance, crystallising in white needle-shaped crystals, and fusing at  $74^\circ$ ;  $\beta$  dichloronaphthalin,  $\text{C}_{10}\text{H}_6\text{Cl}_2$ , exhibiting prismatic-shaped crystals, soluble in ether, and fusing at about  $282^\circ$ ;  $\beta$  tetrachlorotribromodinitronaphthalin,  $\text{C}_{20}\text{H}_9\text{Cl}_4\text{Br}_3$ , a solid, fusing at  $72^\circ$ ; trichloronaphthalin,  $\text{C}_{10}\text{H}_5\text{Cl}_3$ ; heptachlorodinitronaphthalin,  $\text{C}_{20}\text{H}_7\text{Cl}_7$ ; heptachlorodinitronaphthalin,  $\text{C}_{20}\text{H}_7\text{Cl}_7(\text{NO}_2)_2$ ;  $\alpha$  tetrachloronaphthalin,  $\text{C}_{10}\text{H}_4\text{Cl}_4$ ;  $\beta$  tetrachloronaphthalin,  $\text{C}_{10}\text{H}_4\text{Cl}_4$ . All these substances are readily soluble in ether, ligroine, and chloroform, but difficultly so in alcohol; they exhibit the smell of naphthalin. The nitro-products are chiefly yellow-coloured soft substances, difficultly obtainable in pure state.

Some Derivatives of  $\alpha$  and  $\beta$  Naphthalin Sulpho-Acids.—M. Maikopar.—The substances submitted to investigation by the author are:—The chloranhydride of the  $\alpha$  naphthalin sulpho-acid,  $\alpha$   $\text{C}_{10}\text{H}_7\text{SO}_2\text{Cl}$ , a solid substance, exhibiting foliated crystals; readily soluble in ether, sulphide of carbon, and benzol; fuses at  $66^\circ$ .  $\alpha$  amide,  $\alpha$   $\text{C}_{10}\text{H}_7\text{SO}_2\text{NH}_2$ , also a solid substance, readily soluble in water and alcohol, and fusing at  $150^\circ$ .  $\alpha$  mercaptan,  $\alpha$   $\text{C}_{10}\text{H}_7\text{S}$ , an oily fluid, insoluble in water, but soluble in alcohol and ether; its alcoholic solution yields, with an alcoholic solution of acetate of lead, a yellow-coloured precipitate, a lead compound,  $\text{C}_{10}\text{H}_7\text{PbS}$ . Chloranhydride of  $\beta$  naphthalin sulpho-acid,  $\beta$   $\text{C}_{10}\text{H}_7\text{SO}_2\text{Cl}$ , a solid substance, insoluble in water, more difficultly soluble in ether than the  $\alpha$  compound, crystallises in foliated crystals, and fuses at  $76^\circ$ .  $\beta$  amide,  $\beta$   $\text{C}_{10}\text{H}_7\text{SO}_2\text{NH}_2$ , difficultly soluble in water and ether, and soluble in boiling alcohol.  $\beta$  mercaptan,  $\beta$   $\text{C}_{10}\text{H}_7\text{S}$ , insoluble in water, soluble in alcohol and ether, crystalline, and fuses at  $136^\circ$ .

Preparation of Kresotinic Acid from Xylol.—MM. Engelhardt and Latschinoff.—1000 grms. of xylol from coal-tar oil were combined with sulphuric acid; a potassa salt of the sulpho-acid was made, properly purified by re-crystallisation, fused with caustic potassa; the fused mass first treated with water, next with hydrochloric acid, and then treated with ether; the ethereal extract treated with a solution of caustic soda. On evaporating the ether, after decantation, a mixture of xylenols was obtained. The aqueous soda solution yielded, after evaporation and saturation with hydrochloric acid, a substance which on investigation was found to be  $\alpha$  kresotinic acid.

Combination of Sulphuric Acid with the Oxides of Nitrogen.—Dr. Winkler.—The author's researches gave the following results:—(1) Hydrated sulphuric acid does not absorb deutoxide of nitrogen. (2) Hydrated sulphuric acid combines readily, and with evolution of much heat, with nitrous acid; this combination is very strong and intimate, is not destroyed by heating, but immediately so by addition of water; the chamber crystals (viz., those sometimes met with in the leaden chambers of sulphuric acid works) consist of this compound. (3) Deutoxide of nitrogen and oxygen do not, when sulphuric acid is simultaneously present, combine to form, as usual, hyponitric acid, but form nitrous acid, even when oxygen is in excess. (4) Hyponitric acid combines, in gaseous, as well as in fluid state, with hydrated sulphuric acid; but this combination, supposing it to deserve that name in a chemical sense, is very loose and unstable; heat destroys this compound, hyponitric acid is given off, either unchanged, or it is converted into nitrous acid, which combines with the sulphuric acid,

and free oxygen is given off. The mode of this decomposition depends entirely upon the strength of the sulphuric acid under investigation. (5) Sulphuric and nitric acids only form mechanical mixtures together. (6) Nitrous and sulphurous acids yield, when moisture is present (steam in the chambers), hydrated sulphuric acid and deutoxide of nitrogen, which escapes. (7) Hyponitric acid forms, when in contact with moist sulphurous acid, nitrososulphuric acid, exhibiting solid crystalline structure. These researches have been made with the view of illustrating the action of the Gay-Lussac condensers of sulphuric acid works.

Alleged Presence of Dextrine in the Chesnut.—M. Ludwig.—The author has instituted some experiments in order to test the correctness of M. Albini's statement that the well-known eatable chesnuts (*marrons*) should contain from 22.8 to 23.3 per cent of dextrine. The result of the author's experiments is that this fruit does not contain any dextrine at all, which result agrees with those obtained by several other analysts of this fruit.

New Work on the History of Chemistry.—Dr. A. Ladenburg.—Under the title "Vorträge über die Entwicklungsgeschichte der Chemie inden letzten Hundert Jahren" ("Lectures on the History of the Development of Chemistry during the last Hundred Years"), the author has, according to the editor of this periodical, edited a most excellent complementary volume to Kopp's well-known "Geschichte der Chemie." The work alluded to is in the shape of fourteen lectures on the subject; the arrangement is strictly chronological, and, beginning from Lavoisier, contains a complete, yet concise, record of the history of theoretical chemistry up to the present day. This work is highly eulogised by Dr. Fittig, who wrote a review of it for the above-named periodical.

*Les Mondes*, December 30, 1869.

Letters on Geology.—M. L'Abbé Choyer.—Although not exactly belonging to the subjects generally treated of in our publication, we call attention to these letters, which are written with great skill, and contain, condensed, a large amount of very useful and interesting information.

*Cosmos*, January 1, 1870.

Displacement of the Bed of the River Rhine.—M. Bouslot.—The course of the Upper Rhine has very greatly altered, its movement being from west to east (a lateral movement to the course of the downward current) between the Alsatian and Baden banks.

Bread and Railway-Sleepers.—By an order recently issued by M. le Maire de Douai, the bakers of that town have been prohibited from using the wood of old railway sleepers as fuel for their ovens, since many of these sleepers have been impregnated with sulphate of copper, and there is danger that some compound of copper might poison the bread. To the Maire, as head of the local police, is entrusted the proper supervision of everything which may injuriously affect the health of the population.

## NOTES AND QUERIES.

Detection of Opium in Tobacco.—Can you kindly inform me how best to detect small quantities of opium when present in tobacco? Neither Fresenius, nor any other work on analysis that I know of, gives any process that I have found available. By doing so, you will greatly oblige.—E. MORTON.

## MEETINGS FOR THE WEEK.

MONDAY, 17th.—Medical, 8.  
TUESDAY, 18th.—Royal Institution, 3. Prof. Humphry, "On the Architecture of the Human Body."  
Institution of Civil Engineers, 8.  
WEDNESDAY, 19th.—Society of Arts, 8.  
THURSDAY, 20th.—Royal Institution, 3. Prof. Odling, "On the Chemistry of Vegetable Products."  
Royal, 8.30  
Zoological, 4  
Chemical, 8  
Royal Society Club, 6.  
FRIDAY, 21st.—Royal Institution, 8. Prof. Tyndall, "On Haze and Dust."  
Saturday, 22nd.—Royal Institution, 3. Mr. Scott, "On Meteorology."

## TO CORRESPONDENTS.

E. K.—We do not intend to publish the lectures spoken of.  
F. H. Button.—You had better advertise.  
E. Halliwell.—"Laboratory Teaching," by C. L. Bloxam, published by Churchill, will answer your purpose best.



# THE CHEMICAL NEWS.

VOL. XXI. No. 530.

## NOTES FROM THE LABORATORY OF A SUGAR REFINERY.

By WILLIAM ARNOT, F.C.S.  
(Continued from p. 2.)

### V. PRECAUTIONS TO BE OBSERVED IN ESTIMATING THE RELATIVE DECOLOURATIVE POWER OF CHAR.

SIMPLE as the process of testing the relative decolourative power of char samples may appear, very perplexing results are not unfrequently obtained. The object to be aimed at is to make the circumstances which obtain, as nearly as possible, the same on the small scale as on the large, and it is because many little precautionary measures which tend towards the attainment of that equality are usually omitted in the laboratory that such conflicting and apparently inexplicable results are recorded. After many modifications of the process, the author is satisfied, from the results of experiments extending over a considerable period, that if the following points are carefully attended to, the results may be relied upon.

1. It must be decided what the results are to express; whether the relative decolourative power of *equal bulks* or *equal weights* of the chars, *irrespective of size and proportion of grain*, of the chars *uniformly freed from dust*, say by a fifty-mesh sieve, or of *equal weights of equal grains*.

2. According as either of these alternatives is decided upon, the various samples must be thoroughly and intimately mixed, and, if necessary, brought to an uniform dryness and temperature. It is always safest to have them thoroughly dry, and at the temperature of the surrounding air.

3. The various samples are next to be filled into glass tubes (tin may be used, but they preclude observations of a very important kind) provided with perforated false bottoms, covered with layers of cloth, and with taps capable of being accurately regulated. The tubes ought to be about 2 inches wide and 2 feet long as nearly of the same diameter as possible. The best method of filling them is by passing the char through a funnel, keeping the spout of the funnel moving constantly in a circular direction, so as to have the large and small grains equally diffused throughout. To allow the char to run down either at one side, or, to a less degree, in the middle, is to cause to a certainty a separation of the larger grains from the smaller, and thus to create channels through which the liquor has too easy access.

4. See that no tube is touched or shaken more than the others, after the char has been filled in.

5. Sufficient brown sugar liquor, of, say, 24° B, must be prepared, either by diluting raw filtered liquor from the sugar-house to that gravity, or by dissolving as much of an average quality of raw material as will make sufficient liquor for the whole experiment. In the case of preparing it on the small scale, albumen or blood must be liberally used, and the liquor passed through paper filters—coarse French paper answers best. The albumen should not be added till all the sugar has been dissolved, and the temperature at, say, 160° F. An equal quantity of the prepared liquor, as nearly 180° F. as possible, must now be poured uniformly upon the char in each tube.

The rapidity with which the liquor passes through the chars in each case may be noted. Care must be taken to have the top of the char always covered with liquor, and the taps below open. As soon as the liquor begins to drop at the taps they are closed.

5. The tubes being fully charged with liquor (there should be as much left on the top of the char as will serve to force out the liquor in the char), they are put into a cistern of water at 140° F, the water in which will rise to about 1 inch from the mouths of the tubes, the time is noted, and the cisterns, which ought to be felted, covered.

6. At the end of not less than one hour (longer than one hour is sometimes advantageous, particularly if the raw liquor was very brown), the tubes are withdrawn, placed in their stand, and about 2 ounces of liquor run off each; this may be rejected, as the portion between the false bottom and tap is often turbid, and in addition has not been in contact with the char for a sufficient length of time. The remainder of the liquor, *i.e.*, so much as has actually been in contact with the char, may now be run off in three successive quantities for comparison. The results may be compared to any set of standard colours, and recorded accordingly.

7. If these results are not sufficiently instructive, a further quantity of raw liquor may be run on each tube, and the whole transferred as before to the water-bath, which, if felted, will still be hot enough. The second quantity of liquor will be run off with the same precautions as the first, and the results will show the *relative persistency* of the chars under trial.

If the taps are large the liquor will be likely to run off too rapidly, and, in that case, they had better be partially and uniformly closed.

If it is found that the liquor runs through one sample particularly slow, and through another particularly fast, it is quite admissible to assist the one by suction, and to check the other by closing the taps, but this should not be done unless in extreme cases, and the fact of having so assisted or retarded the process should always be noted.

It is scarcely necessary to mention the several points wherein the foregoing differs from the course usually pursued in testing chars, and yet it may be useful briefly to indicate some of these.

Too little care is usually bestowed upon the selection and preparation of the samples. The tubes used are, as a rule, too small: the char cannot be run so uniformly into small tubes as large ones. The samples once charged with liquor are not usually kept warm: it is essential that they should. Some chars act powerfully at low temperatures, while others require a considerable amount of heat to bring out their maximum decolourative power; care must, however, be taken that the temperature employed does not exceed that attained on the large scale in the refining process. The fact just noted does not seem to have been much investigated; it is worthy of careful consideration, not only on the part of experimentalists, but also by the practical refiner. One sample of char, known to be of very inferior decolourative power on the working scale, persistently gave results, by the usual method of testing in the laboratory, equal to the very finest chars obtainable, but when kept at an elevated temperature along with the finer samples, in the manner indicated above, its inferiority was at once manifest. The facts in this case were that the inferior char readily yielded *all* its decolourative power at the low temperature, while the finer samples required the influence of heat to call their whole power into action.

### VI. THE CONSTITUENTS OF CHAR, IMPORTANT AND UNIMPORTANT.

In the absence of a knowledge of the refining process, and the circumstances attendant on the use and revivification of animal charcoal, much time may be unprofitably spent over an analysis of that agent. While it is always desirable to have analyses carefully and accurately executed, the analyst should be able to discriminate between the essential and non-essential elements or compounds in the substance before him, and, while he aims at general accuracy, more than usual care should be bestowed upon substances the presence or absence of which mark the value of the agent under examination.



The points of greatest importance in an analysis of animal charcoal are the carbon, the carbonates, and the iron; the decolouriser, the neutraliser, and the destroyer. Under certain circumstances the sulphates may also be included in the list, and in the case of new unused char the alkaline salts should be carefully estimated. These essential points carefully ascertained, no modification of them should be thought of, whatever the phosphates may come out. If the analysis should come to 105, ten to one but the phosphates are to blame and not the carbon and carbonates. The phosphates are comparatively unimportant, and when it is remembered how various are the methods employed, and how faulty some of them are,\* errors under that head need not be greatly worded at. There is no excuse whatever for error in the carbon, the process is simplicity itself; the carbonates can be quickly and accurately estimated by the calcimeter (Note I.), while the iron, after some little practice, can be safely got at by Penny's process, using a very dilute solution of bichromate. The iron is always in the state of protoxide, faint traces of peroxide excepted, owing to the reducing action of the carbon in the re-burning. Of course, these remarks are intended to apply exclusively to commercial samples for use in the refinery. When char is to be sold for the manufacture of manure the circumstances are altered, and the phosphates become the essential element in the analysis.

ON THE  
METHODS OF ANALYSIS  
AND THE  
COMPOSITION OF VARIOUS CHEMICAL  
MANUFACTURING PRODUCTS.

By M. GASTON TISSANDIER.  
(Continued from vol. xx., p. 231.)

ANIMAL BLACK.

The consumption of animal black in sugar factories is very considerable; and this product now plays a prominent part in commerce. After having been used in the clarifying of sugar, animal black is sometimes employed in agriculture; but on this point we shall examine it more particularly in speaking of manures.

**Ash.**—The sample to be analysed is ground and sifted; 2 grms. are taken and calcined in a platinum crucible till the perfectly white residue contains no further traces of carbon. This residue, when weighed, gives the proportion of ash contained in 2 grms. of material. The carbon and moisture are given by difference. Care must be taken to moderate the heat in this calcination, so as not to decompose the carbonate of lime contained in the ash.

**Carbon.**—5 grms. of animal black are dried at 110° in a stove, or in a paraffin-bath; the loss of weight gives the moisture, which, subtracted from the loss by calcination, furnishes the proportion of carbon.

**Silica.**—The ash obtained by the calcination of animal black is dissolved in water acidulated with chlorhydric acid; it is slightly heated, and the insoluble siliceous remainder is filtered and weighed.

**Phosphate of Lime.**—To the filtered solution is added a slight excess of ammonia, which precipitates all the phosphate of lime ( $\text{PO}_5, 3\text{CaO}$ ); it is filtered, and the precipitate is dried, calcined, and weighed.

**Carbonate of Lime.**—The liquid, separated by filtration from the phosphate of lime, contains carbonate of lime, which is precipitated at the boiling-point by oxalate of ammonia. The precipitate of oxalate of lime is collected; this it is well to filter and wash by decantation, pouring the washing-water on the filter. The calcination of this precipitate necessitates, as is well-known, some

precautions. The oxalate of lime must be heated to a sufficient temperature (approaching red-heat), to transform it into carbonate of lime; but the heat must not be so great as to decompose the residue of carbonate of lime. After having weighed the carbonate of lime, the operation may be controlled in the following manner:—The precipitate is moistened with sulphuric acid; it is calcined, in order to get rid of the excess of this acid, and the sulphate of lime obtained is weighed. This amount ought to correspond with the quantity of carbonate of lime, if the operation has been properly executed. Animal black contains traces of magnesia, which can be estimated in the form of ammonico-magnesian phosphate.

**Soluble Salts.**—50 grms. of animal black are weighed and thrown into a little stoppered flask containing about 50 c.c. of distilled water; this is well shaken for a few minutes, and then filtered. The insoluble residue is re-digested in a fresh quantity of water; and this is repeated several times, so as to eliminate the whole of the soluble salts. The filtered liquid is evaporated over the sand-bath in a little porcelain capsule; the dry residue is weighed, and its weight gives the proportion of soluble salts. These salts consist of alkaline chlorides, sulphates, and carbonates; they also contain traces of sulphate of lime and sulphide of calcium.

*Composition of Animal Black used in Sugar Refining.*

Substances Estimated.	I.	II.	III.	
Water .. .. .	2.00	1.37	1.21	} Loss on calcination.
Carbon .. .. .	8.42	9.90	11.12	
Carbonate of lime ..	14.92	13.80	12.22	
Phosphate of lime ..	72.50	72.25	74.43	} Ash.
Silica .. .. .	1.80	2.50	0.40	
Soluble salts .. ..	0.36	0.18	0.62	
Total .. .. .	100.00	100.00	100.00	

**Decolourising Power.**—We have devised a method which enables us to compare the decolourising power of an animal black with that of another black of good quality, taken as a standard, and to represent the relation of the two decolourising powers by an exact number.

10 grms. of the standard black, and 10 of the black under assay, are weighed; the two samples, finely pounded, are placed separately on two filters of the same size.

A solution of caramel in water is prepared, so as to produce a rather dark colour, somewhat like that of weak tea. The first standard black is moistened with 20 c.c. of this solution, which runs through colourless; 20 more c.c. are passed through, and so on till the liquor passes coloured. When it presents just the same shade as the unfiltered solution of caramel, the operation is stopped.

The same experiment is made with the black under assay, placed on the second filter, and the quantity of solution required to be passed through until it is of the same colour noticed, as in the preceding experiment. Let us suppose that the standard black decolourised eight pipettes full of the caramel solution, and the black under assay only four: we say that the decolourising power of the latter is equal to one-half, relative to that of the former.

A solution of caramel may be kept ready prepared, so as to serve as a testing liquid.

ACETIC ACID.

Acetic acid, sometimes called, in commerce, pyroligneous acid, generally contains about 40 per cent of acetic acid,  $\text{C}_4\text{H}_4\text{O}_4$ ; it is sold by the acidimetric standard, which is determined by means of a titrated alkaline liquid.

**Acidimetric Standard.**—Preparation of the Alkaline Liquid.—We have already shown how the alkalimetric sulphuric acid may be prepared accurately; this well-verified solution, containing 100 grms. of sulphuric acid per litre, is the basis of the preparation of the

\* CHEMICAL NEWS, vol. xi., p. 49.



alkalimetric liquid which, in laboratories, is used to effect nitrogen determinations or to take acidimetric standards.

Any quantity whatever of pure caustic soda—15 or 18 grms., for instance—is dissolved in a litre of water. 10 centimetres of the normal sulphuric acid liquor (containing 1 grm. of  $\text{SO}_3\text{HO}$ ) are taken and poured into a small precipitating glass; to this is added some sensitive tincture of litmus, and the solution of caustic soda poured into it drop by drop by means of a graduated burette, divided into tenths of c.c., till the red litmus becomes blue—that is to say, till the acid is saturated. Let us suppose that 50 c.c., or 500 divisions, of our alkaline solution are required to saturate 10 c.c. of the titrated sulphuric acid liquid. We know that 500 divisions saturate 1 grm. of sulphuric acid, and we can calculate, according to the equivalents, what quantity of acetic acid will saturate a certain volume of our liquid; we know, for example, that 500 divisions ought to saturate 1.224 grms. of acetic acid,  $\text{C}_4\text{H}_4\text{O}_4$ :—in fact,  $\frac{49(\text{SO}_3\text{HO})}{60(\text{C}_4\text{H}_4\text{O}_4)} = \frac{1}{x}$ .

Before thus standardising the alkaline liquor of caustic soda, it is well to add some slaked lime, to prevent it from carbonating, which would interfere with the sharpness of the colouration of the red litmus into blue. Before using this liquor, the bottle which contains it is shaken, and left to settle, so that the lime may be deposited at the bottom; the solution, becoming clear in a few minutes, is then poured into the graduated burette, which is used to take the standard of pyroligneous acid under assay.

According to arrangement between the buyer and seller, the standard of this acid is taken either by *volume* or by *weight*. In the former case, 1 c.c. of acetic acid is saturated, in the latter 1 grm.

In order to take the standard by weight, a small glass, containing in it a 10-grm. weight, is tared on a sensitive balance. Equilibrium being established, the 10-grm. weight is taken out, and the acetic acid to be tested is then gradually poured into the glass by means of a small tube, so as to regain the equilibrium. We have thus, by double weighing, obtained 10 grms. of acetic acid, which are to be diluted with water so as to give a volume of 100 c.c.

After this solution has been rendered homogeneous by shaking, 10 centimetres of it are removed, corresponding to 1 grm. of acetic acid. Instead of directly weighing 1 grm. of the acid to be tested, it is better to weigh 10 grms. of it, as we have indicated; because, in case of a verification being needed, it is easier to measure 10 c.c. than to commence a fresh weighing.

The 10 centimetres deducted are placed in a precipitating jar, litmus is added, and the alkaline soda liquid poured in, drop by drop, till the litmus becomes clearly blue. If 150 divisions have been used, we shall obtain the acidimetric standard of pyroligneous acid by the following equation:—

500 divisions saturate .. .. 1.224 grs. of  $\text{C}_4\text{H}_4\text{O}_4$   
150     ,,     will saturate .. ..  $x$ .

whence—

$$x = 0.3672.$$

100 grms. of the assayed acetic acid contain, then, 36.72 grms. of  $\text{C}_4\text{H}_4\text{O}_4$ , which is expressed by saying that its standard is 36.72°.

When the standard is taken by volume the operation is the same; only, instead of weighing 10 grms. of the acid, 10 c.c. are measured.

**Examination for Mineral Acids.**—Acetic acids are sometimes adulterated with mineral acids (chlorhydric and sulphuric, &c.), which augment their standard.

To detect their presence, 50 c.c. of acetic acid are heated to the boiling-point with 1 or 2 centigrms. of starch, and left to boil about twenty minutes. When the liquid has become cold, some drops of tincture of iodine are poured into it. If a blue colouration of iodide of starch occurs, the acetic acid contains no mineral acids;

but if this colouration is not produced, we may be certain of the presence of mineral acids, which, under the action of heat, have transformed the starch into dextrine, and thus prevented the formation of the iodide. Care must be taken to pour the iodine into the cold liquid, for iodide of starch is decolourised spontaneously under the action of heat. Chlorhydric acid may also be immediately detected, by adding to the acetic acid a few drops of nitrate of silver; and the presence of sulphuric acid is discovered by chloride of barium. In the latter case, it must not be forgotten that chloride of barium is insoluble in acids, and that the acetic acid ought to be diluted with a sufficiently large quantity of water to avoid the possibility of error from this cause.

Pyroligneous acids generally standardise 39° to 40°; however, this figure is not absolute. We have sometimes met with samples containing only 34 per cent of acetic acid, others having 46 to 50 per cent, and even still larger quantities.

(To be continued).

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ON THE  
METHOD OF ANALYSING SILICATES THAT  
DO NOT GELATINISE WITH HYDROGEN  
CHLORIDE.\*

By NEVIL STORY-MASKELYNE, M.A.,  
Professor of Mineralogy in the University of Oxford, and Keeper of  
the Mineral Department, British Museum.

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THE process is conducted in an apparatus of the following constructions:—A platinum retort, 30 c.c. in capacity, is fitted with a tubulated stopper of the same material, which reaches nearly to the bottom; a small tube, entering the vertical tube of the stopper at an angle above the neck of the retort, conveys hydrogen to its interior. The vertical tube can be closed, either by a stopper of platinum or by a funnel of that metal, stopped in like manner at the top, and having a fine orifice at its lower extremity.

To the side of the retort, just below its neck, a straight delivery-tube is fixed, which in its turn fits into another platinum tube that, after taking a curve into a vertical position, is enlarged into a cylinder, which passes a considerable distance down a test-tube. The latter, into which the delivery tube is fitted with a cork, holds 7.5 c.c., or 6.6 grms. of strong ammonia of the sp. gr. 0.88.

The gas-delivery tube inserted in the side of this receiver dips into some more ammonia in a second test-tube.

The pounded mineral, from 0.2 to 0.5 grm. in quantity, and a small platinum ball, are placed in the retort, and the stopper luted to it with gutta percha, and cemented air-tight in its place with caoutchouc and gutta-percha varnish. The funnel, filled with perfectly pure hydrogen fluoride, is now introduced into the tubulure of the stopper, the tap opened, and the acid allowed to run down into the retort. This acid contains about 32 per cent of absolute hydrogen fluoride—that is to say, a funnel of this reagent contains 1.12 grms. of acid, capable of rendering gaseous 0.84 grm. of silica, and of neutralising 0.95 grm. of ammonia. The funnel is now replaced by a little platinum stopper, and the orifice secured air-tight with gutta-percha varnish. Pure hydrogen is then allowed slowly to traverse the entire apparatus; the retort is placed in a water-bath at 100° C. for two hours, and occasionally slightly shaken to set the ball rotating. During the operation, a trace only of silicium difluoride passes over.

The retort is next transferred to a paraffin-bath, and the temperature is cautiously raised. At first, hydrogen fluoride passes over, and at this point of the process the flow of hydro-

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\* Extracted from a paper "On the Mineral Constituents of Meteorites," communicated to the Royal Society.



gen requires some attention to prevent regurgitation of the ammonia. At about  $132^{\circ}\text{C}$ ., in the case of the silicates mentioned in this memoir, the silica first becomes visible in fine flocks in the ammonia of the receiver, and in another minute the whole is cloudy.

In eight minutes, the rise of the thermometer to  $145^{\circ}\text{C}$ . has brought over so much difluoride that the contents of the tube are semisolid, and nearly the whole of it has passed over. The temperature is then raised to  $150^{\circ}\text{C}$ ., and the retort allowed to cool. The process is next repeated with a fresh charge of acid and ammonia. If no more than 0.2 grm. of silicate be taken, twice charging of the retort is sufficient; but with 0.5 grm., three or four repetitions of the process are required. In short, the operation is continued with fresh reagents till no flock of silica forms in the receiver. Finally, 0.75 c.c. of sulphuric acid is introduced into the retort, and the temperature again raised to  $160^{\circ}\text{C}$ ., the stream of hydrogen being continued as before.

The several ammoniacal charges are poured into a platinum dish, together with the washings of the delivery-tube and the two test-tubes, and slowly evaporated in a water-bath with continued stirring.

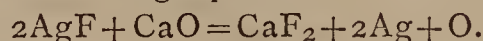
At a point in the evaporation just before the solution becomes neutral, and the ammonium fluoride begins to turn acid, the entire silica in the dish will have been dissolved by the fluoride. The process is gradual, but the moment when the solution is complete is easily determined. Then, the dish being removed, potassic chloride is added in slight excess, together with absolute alcohol equal in volume to the contents of the platinum vessel. Potassium fluosilicate precipitates, which, after the lapse of twenty-four hours, is filtered, weighed with a mixture of equal volumes of absolute alcohol and water, dried, and washed. The results are accurate. In the retort are the bases in the form of sulphates, the treatment of which calls for no further remark.

## ON FLUORIDE OF SILVER.\*

By GEORGE GORE, F.R.S.

THIS communication treats of the formation, preparation, analysis, composition, common physical properties, and chemical behaviour of fluoride of silver.

The salt was prepared by treating pure silver carbonate with an excess of pure aqueous hydrofluoric acid, in a platinum dish, and evaporating to dryness, with certain precautions. The salt thus obtained invariably contains a small amount of free metallic silver, and generally, also, traces of water and of hydrofluoric acid, unless special precautions mentioned are observed. It was analysed by various methods. The best method of determining the amount of fluorine in it consisted in evaporating to dryness a mixture of a known weight of the salt, dissolved in water with a slight excess of pure and perfectly caustic lime in a platinum bottle, and gently igniting the residue at an incipient red heat until it ceased to lose weight. By taking proper care, the results obtained are accurate. The reaction in this method of analysis takes place according to the following equation:—



Sixteen parts of oxygen expelled equal 38 parts of fluorine present. One of the methods employed for determining the amount of silver consisted in passing dry ammonia over the salt in a platinum boat and tube at a low red heat. The results obtained in the various analyses establish the fact that pure fluoride of silver consists of 19 parts of fluorine and 108 of silver.

Argentiferous fluoride is usually in the form of yellowish-brown, earthy fragments; but, when rendered perfectly anhydrous by fusion, it is a black, horny mass, with a

superficial satin lustre, due to particles of free silver. It is extremely deliquescent and soluble in water. One part of the salt dissolves in 0.55 part by weight of water at  $15.5^{\circ}\text{C}$ .; it evolves heat in dissolving, and forms a strongly alkaline solution. It is nearly insoluble in absolute alcohol. The specific gravity of the earthy-brown salt is 5.852 at  $15.5^{\circ}\text{C}$ . The specific gravity of its aqueous solution,  $15.5^{\circ}\text{C}$ ., saturated at that temperature, is 2.61. By chilling the saturated solution, it exhibited the phenomenon of supersaturation, and suddenly solidified, with evolution of heat, on immersing a platinum plate in it. The solution is capable of being crystallised, and yields crystals of a hydrated salt. The act of crystallisation is attended by the singular phenomenon of the remainder of the salt separating in the anhydrous and apparently non-crystalline state, the hydrated salt taking to itself the whole of the water. The fused salt, after slow and undisturbed cooling, exhibits crystalline markings upon its surface.

The dry salt is not decomposed by sunlight. It melts below a visible red heat, and forms a highly lustrous, mobile, and jet-black liquid. It is not decomposed by a red heat alone; but, in a state of semi-fusion, or of complete fusion, it is rapidly decomposed by the moisture of the air, with separation of metallic silver. Dry air does not decompose it. In the fused state, it slightly corrodes vessels of platinum, and much more freely those of silver.

The salt, in a state of fusion, with platinum electrodes, conducts electricity very freely, apparently with the facility of a metal, and without visible evolution of gas or corrosion of the anode. A silver anode was rapidly dissolved by it, and one of lignum-vitæ charcoal was gradually corroded. A saturated aqueous solution of the salt conducted freely with electrolysis, crystals of silver being deposited upon the cathode, and a black crust of peroxide of silver upon the anode; no gas was evolved. With dilute solutions, gas was evolved from the anode. By electrolysis of anhydrous hydrofluoric acid with silver electrodes, the anode was rapidly corroded.

The electrical order of substances in the fused salt was as follows, the first-named being the most positive:—Silver, platinum, charcoal of lignum-vitæ, palladium, gold. In a dilute aqueous solution of the salt, the order found was:—Aluminium, magnesium, silicon, iridium, rhodium, and carbon of lignum-vitæ, platinum, silver, palladium, tellurium, gold.

The chemical behaviour of the salt was also investigated. In many cases, considerable destruction of the platinum vessels occurred, either in the experiments themselves, or in the processes of cleaning the vessels from the products of the reactions.

Hydrogen does not decompose the dry salt, even with the aid of sunlight; nor does a stream of that gas decompose an aqueous solution of the salt; but the dry salt is rapidly and perfectly decomposed by that gas at an incipient red heat, its metal being liberated.

Nitrogen has no chemical effect upon the salt, even at a red heat, nor upon its aqueous solution. Dry ammonia gas is copiously absorbed by the dry salt. In one experiment, the salt absorbed about 844 times its volume of the gas. The salt, in a fused state, is rapidly and perfectly decomposed by dry ammonia gas, and its silver set free. A saturated solution of the salt is also instantly and violently decomposed by strong aqueous ammonia.

Oxygen has no effect either upon the dry salt at  $15^{\circ}\text{C}$ . or at a red heat, nor upon its aqueous solution. Steam perfectly and rapidly decomposes the salt at an incipient red heat, setting free all its silver. No chemical change took place on passing either of the oxides of nitrogen over the salt in a state of fusion.

By passing anhydrous hydrofluoric acid vapour over perfectly anhydrous and previously-fused fluoride of silver, at about  $60^{\circ}\text{F}$ ., distinct evidence of the existence of an acid salt was obtained. This acid salt is decomposed by slight elevation of temperature.

Numerous experiments were made to ascertain the

\* Abstract of a paper read before the Royal Society.



behaviour of argentic fluoride, in a state of fusion, with chlorine; and great difficulties were encountered, in consequence of the extremely corrosive action of the substances when brought together in a heated state. Vessels of glass, platinum, gold, charcoal, gas carbon, and purified graphite were employed.\* By heating the salt in chlorine, contained in closed vessels formed partly of glass and partly of platinum, more or less corrosion of the glass took place, the chlorine united with the platinum and fluoride of silver to form a double salt, and a vacuum was produced. By similarly heating it in vessels composed wholly of platinum, the same disappearance of chlorine, the same double salt, and a similar vacuum resulted. Also, by heating it in vessels composed partly of gold, an analogous double salt, the same absorption of chlorine, and production of rarefaction was produced. And, by employing vessels partly composed of purified graphite, a new compound of fluorine and carbon was obtained.

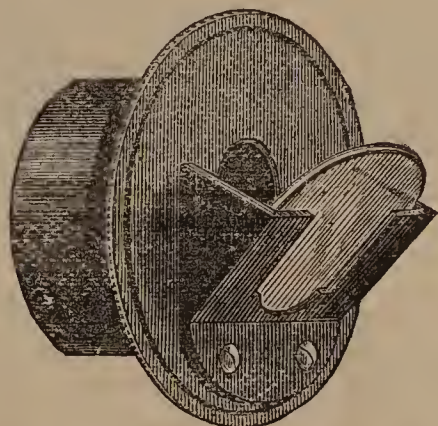
## ON MICROSCOPICAL MANIPULATION.†

By W. T. SUFFOLK, F.R.M.S.

(Continued from p. 21).

ANOTHER contrivance, and one which has the recommendation of being procured at a very small cost, is the *neutral tint reflector* (Fig. 40).\* It con-

FIG. 40.



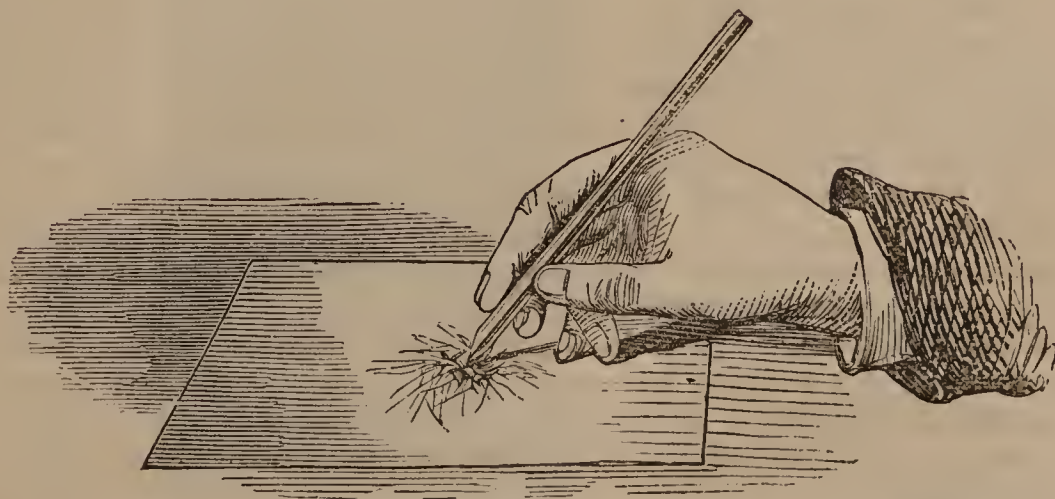
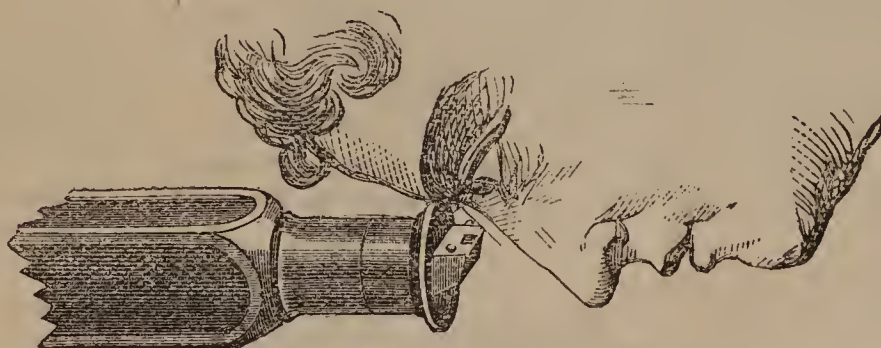
sists of a small plate of glass, with surfaces accurately parallel, and slightly coloured, so as to improve its reflecting qualities, but not sufficiently dark to prevent the paper from being easily seen through it. This is placed, as before, at an angle of  $45^\circ$ . As the instrument is commonly constructed, the tinted glass is a fixture, and the setting too long; so that the mirror is removed to a greater distance than is advantageous from the front glass of the eye-piece; this contracts the field so much, when any but an eye-piece of low power is employed, that it is almost useless. This defect is remedied in the form here represented, in which the mirror is brought as close as possible to the eye-glass. The tinted glasses are also removable, so that a change of tint may be made, as it will be found sometimes that one tint suits the eye better than another. Some microscopists, instead of tinted glass, use a piece of thin cover-glass, which gives a very good reflection, and can easily be used with this form of setting, which

also allows a small right-angled prism to be placed in it, and which, although not usually supplied with the instrument, will be found a serviceable addition. Its use will be described with that of the preceding instruments. This reflector gives a reversed view of the object by a single reflection, as in the steel mirror of Soemmering, but, unlike it, the paper, instead of being viewed round its edge, is seen through the glass.

As these instruments have much in common, the use of them may very conveniently be described together, noticing, in passing, such peculiarities as render them more or less serviceable, each having its own special advantages and defects.

The microscope should be placed with the body in a horizontal position (Fig. 41), and, if the stand is not of suitable height, it should be placed on a box or other convenient support. The best distance between the eye and the paper, for general purposes, is 10 inches, this being the standard distance employed in estimating magnifying power; but any other that is convenient may be made use of, bearing in mind that the greater the distance from the eye-piece the larger will be the image; so that the size of the picture is capable of being regulated at will, the only limit being the difficulty of seeing the pencil when too near, and the trouble of drawing with a

FIG. 41.



pencil attached to a long stick if the paper is greatly removed from the usual position.

With respect to the images formed by the several instruments, the camera lucida, as it reflects doubly, has the advantage of giving the image in the same position as when viewed through the micro-

\* In the next communication there will be described the results obtained with vessels formed of other materials.

† The substance of a course of lectures delivered to the members of the Quekett Microscopical Club, January—April, 1869.



scope directly, which, owing to its perfect internal reflection, is brilliant and well defined. Soemmering's mirror and the tinted-glass reflector reverse the image, just as an ordinary looking-glass. This is of little consequence if only slight outline sketches are required; but, when the drawing is to be highly finished, which is always done by viewing the object directly through the microscope, this reversal becomes excessively troublesome to those who are not, like engravers and lithographers, accustomed to reverse their drawings.

With a view to obviating this inconvenience, the author uses the small right-angled prism before mentioned, when drawing with the neutral tint reflector, which enables the drawing to be completed, as it reverses the image just as the tinted glass; and, as the reflection from the internal surface of the prism is total, the view is nearly as brilliant as that received directly from the microscope.

Only one eye is to be used while drawing, and great care should be taken to maintain its position steadily until the sketch is finished (Fig. 41). With the camera lucida and Soemmering's mirror, the maintenance of this position is somewhat painful, when much prolonged, owing to the divided manner in which the eye receives the light from the object and the paper; and frequently the power of seeing the pencil and drawing is lost after a few minutes' use. With the neutral tint reflector, the view of both object and paper is much easier; and, when the reversal of the picture is immaterial, it is, as far as comfort is concerned, much to be preferred.

The illumination is a matter of great importance in making use of drawing instruments. Care should be taken not to light the object more than is necessary, while it will generally be found advisable to illuminate the paper rather strongly. If the image of the object is too bright, it will be found impossible to see either the pencil-point or the line it is tracing. The camera lucida requires far more care, in this respect, than the tinted mirror.

The author's practice is always, when drawing, to use two lamps; one the little camphine lamp before mentioned (CHEMICAL NEWS, vol. xx., p. 158), which is used exclusively for the microscope; the other a large paraffin lamp, with shade, which lights the paper. By this means, the relative illumination of the object and paper can be very nicely adjusted—a matter of some difficulty when only one lamp is employed.

These instruments are only used to secure an outline, and mark out other main points, the details being filled in by free-hand drawing, which will be found comparatively easy when an accurate outline is obtained to work upon.

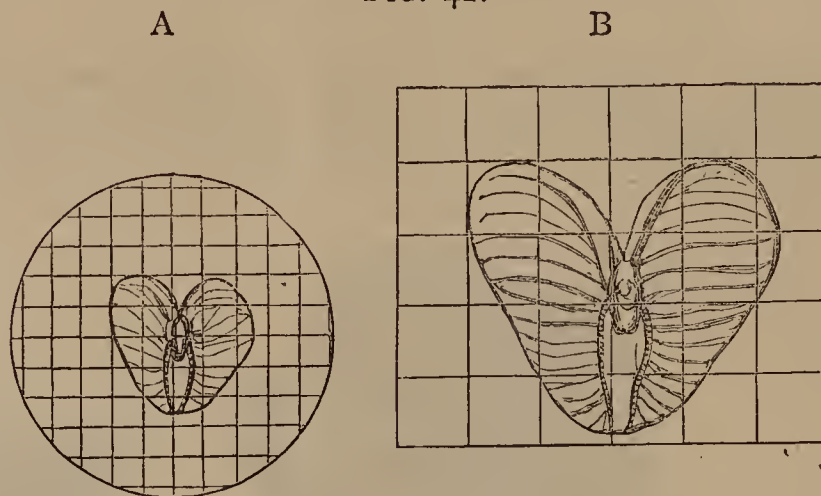
If, when the sketch is finished, before removing the reflector, a ruled micrometer-scale is placed upon the stage of the microscope in the place of the object, the lines can be seen projected upon the paper, just as any other object, and, by tracing some of them, a scale can be formed by which the drawing can readily be measured with a pair of compasses, like a map. This is one of the simplest methods of micrometry.

The magnifying power of the microscope can also easily be ascertained by means of the camera lucida or neutral tint reflector and the stage micrometer. By placing the microscope in the position for drawing, taking care that the eye-piece is 10 inches from the paper, the image of the micrometer-lines, instead of

being projected on a sheet of paper, is caused to fall upon a divided scale; and, from the amount covered by it, the magnifying power can be estimated; for instance, the 1-inch objective, with No. 1 eye-piece, causes 0.01 of the micrometer to cover 0.5 inch of the measure on the table; the magnifying power will be 50 diameters. The  $\frac{1}{4}$ -inch makes 0.01 cover 2.5 inches; the power will be 250 diameters. And so on, for other objectives and eye-pieces.

Finding the placing of the microscope in a horizontal position troublesome, and not liking the constraint of the camera lucida, the author thought that the method of enlarging and reducing drawings commonly employed by artists might be adapted to the microscope. This process consists of ruling a series of squares of convenient size on the drawing to be copied, or placing over it a lattice of threads crossed in squares. The copy is then made upon a sheet of paper or other material, ruled, either in augmented or diminished proportion, as may be required. Messrs. R. and J. Beck ruled a disc of glass in squares (Fig. 42), the side of each of which,

FIG. 42.



for convenience sake, was made to correspond with 10° of Jackson's eye-piece micrometer. This disc was dropped into the eye-piece, and rested on the stop, so that, when in use, the field appeared similarly divided (Fig. 42, A). A sheet of paper (Fig. 42, B), ruled in squares of convenient size was employed to make the drawing upon; and, by noticing how many squares the object covered, the direction of the various lines, whether, for instance, they ran through the sides or the corners of the squares, and setting them down in similar positions on the ruled sheet, the author found that an accurate drawing might be made with great ease and expedition, and without the trouble of moving the microscope out of the usual inclined position, which is generally the most comfortable for observation. The use of the binocular did not cause any impediment, and the ruled disc only slightly interfered with the definition of the object, and could easily be removed, when its services were no longer required, without disturbing the arrangement of illumination, object, or instrument. When large diagrams are wanted, nothing more is necessary than to use a large sheet of paper, ruled in squares of suitable dimensions, and the object can be rapidly delineated in this augmented proportion.

The measurements can be made either by obtaining the value of the side of a square of the disc with each objective and eye-piece, by means of the stage-micrometer, or by selecting two well-marked dots or lines in the objects, and measuring their distance with the eye-piece micrometer, and using the distance obtained from the corresponding part of the drawing



as a standard for the formation of a scale. These processes will be explained in the account shortly to be given of micrometers.

When many sheets of paper are required to be ruled in squares (and it will be found in practice that two or three sizes will be in general request), they can easily be made by placing a perforated sheet over the sheet to be ruled, and rubbing over it a piece of wash-leather dipped in black-lead powder, which will pass through the holes and leave a series of dotted lines on the sheet below, which will be sufficiently distinct, and have the advantage of being rubbed out with a very light touch of the india-rubber, without affecting the pencil-lines of the drawing. The perforated sheets are easily made by means of a comb-like steel punch used by harness-makers, which cuts a row of small pin-holes, equal in length to its own width, which may be an inch or more. This instrument can be obtained at the better class of tool-shops.

Some microscopists have endeavoured, with more or less success, to make drawings from the image of the object projected upon a sheet of paper or ground glass, after the manner of the solar microscope or camera obscura. All the contrivances for this purpose seem to have the defect of giving a very faint image, unless a light of greater intensity than that of ordinary lamps is employed. The image must be received in the dark, which is troublesome, as the outline cannot easily be seen. The process is only applicable to those objects which can be viewed by transmitted light, besides putting the microscope more out of its usual position than the camera lucida and other reflecting instruments.

(To be continued.)

### DUBOSCQ'S NEW COLORIMETER.\*

M. DUBOSCQ has submitted to the Academy of Sciences his new colorimeter for measuring the differences of tint in solutions. The two liquids are placed in the two cylindrical vessels, c, c', of glass, fixed side by side, before the vertical shelf of the colorimeter.

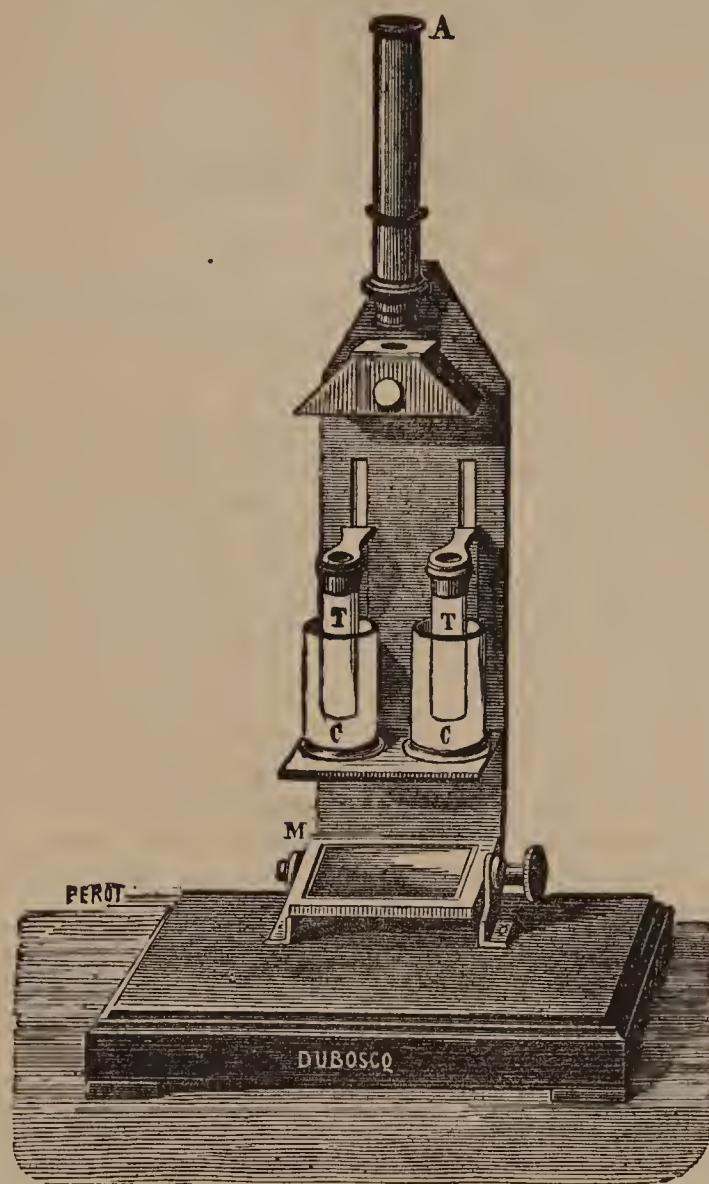
In the two vessels, two tubes of smaller diameter,  $\tau$ ,  $\tau'$ , closed at the lower extremity by a disc of glass, may be raised and lowered by means of the movable pinions engaged by two racks cut into the vertical table. To each pinion is fastened a vernier, which is moved under a graduated scale, and which measures the distance between the bottom of the vessels and the lower disc of the movable tube.

The luminous rays transmitted by the two columns properly illuminated by a mirror, M, placed above, and moved around in a horizontal axis, suffer each two reflections, within one of Fresnel's rhombs, P, P', and then arrive in the same field of vision, in such a manner that each shall illuminate the half of the field with a semi-disc or circle of yellow colour, more or less intense. These colours are observed with a small lens, which is nothing but the base of a terrestrial eye-piece, formed of four glasses, and which magnifies sufficiently, so that the field may be illuminated by the coloured plates with perfect uniformity.

The colours are proportional to the height of the columns if the liquid contain the same proportion of caramel; or proportional to the richness of the liquid in caramel, if the two columns have the same height.

\* For this description as well as for the illustrative cuts we are indebted to the courtesy of Professor Morton.

In the last case, if we cause the height to vary, we have the same shade on these two semi-discs.



Suppose that the standard solution is in the cup to the right, and that we lower the interior disc or movable tube

to 20 millimetres from the bottom of the cup; we will thus have a column of 20 millimetres, which gives to the half disc of the left-hand side a pale yellow colouration. Admitting, then, that the half disc at the right has the same colouration, but that the column of the liquid placed in the cup to the left has not a height of 40 millimetres, this informs us that the solution to be tried contains a proportion of caramel more than that contained in the standard liquid.

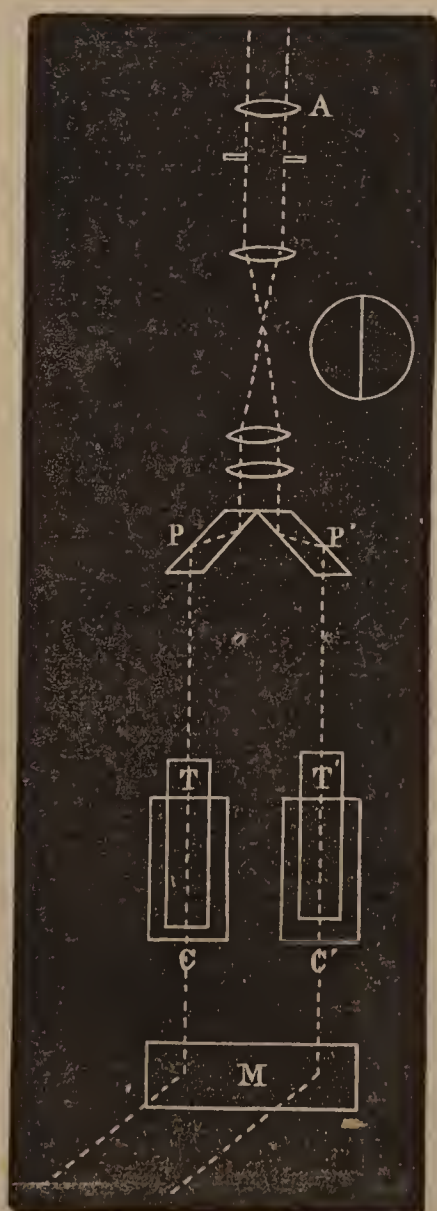
In fact, for the same colour on the two semi-discs, the proportions of caramel contained in the two liquids are inversely as the height which we give to the column of the liquids.

One hundred centimetres of the solution tried, contained, then, in the case we speak of,

$$\frac{0 \text{ gr. } 2}{2}$$

of caramel.

If we have dissolved, for





example, 10 grammes of syrup in 100 c.c. of water, we should know that 10 grammes of the syrup contained one d. c. g. of caramel.

## NOTICES OF BOOKS.

*Addresses at the Inauguration of Charles William Eliot as President of Harvard College*, Tuesday, October 19, 1869. Cambridge (Mass.): Sever and Francis. 1869. 65 pp., 8vo.

ON the 19th of September, 1868, Dr. Thomas Hill resigned the office of President of Harvard College; and on the 19th of October, 1869, Mr. Charles William Eliot was formally inducted into office in his stead. Mr. Eliot is known to many of us as a writer on chemistry: to some of us as a man of singularly sound and accurate thought, of high culture and of liberal views, and as a kindly genial gentleman. Let us glance for a moment at the addresses which were delivered at the inauguration of Mr. Eliot, and specially at his own, which derives additional interest from the fact that he has paid special attention to the subject of education, and has watched the growth of the educational system of his own country, comparing it with those of the principal European nations, and particularly with our own college system.

The form of induction into office of the president of a college is very different in America from that which is adopted in England. In the invitation to the Alumni of Harvard College, it is stated that "A procession will be formed in Gore Hall, at half-past two p.m., under the direction of Leverett Saltonstall, Esq., and the exercises in the Church will begin at three o'clock p.m. Immediately after the exercises in the church, President Eliot will hold a reception at the President's House in Quincy Street." The "Exercises" on this occasion were nine in number, and consisted of:—

1. "Music by the Band.
2. Choral: 'Let us with a gladsome mind.'
3. Prayer by the Rev. Dr. Peabody.
4. Congratulatory Address in Latin, by John Silas White, of the Senior Class.
5. Induction into Office, by John Henry Clifford, President of the Board of Overseers.
6. Chorus: 'Domine, salvum fac Præsidem Nostrum.'—J. K. Paine.
7. Address by President Eliot.
8. Chorus from the Antigone of Sophocles: 'Πολλὰ τα δεινά κούδεν ἀνθρώπου δεινότερον πέλει.' 'Wonders in Nature we see.'—Mendelssohn.
9. Benediction, by Rev. Dr. Walker."

The Latin address is, as we should expect, less florid and elaborate than those which are given on somewhat similar occasions in the French and German Universities; the "Amplissimi, Nobilissimi, Præstantissimi Eminentiissimi," commencement is omitted, and it begins simply and to the point, "Convenimus hodie," while it is concluded by an exceedingly apt and reverent phrase:—"Precamur autem a Deo Optimo Maximo ut signis illis venustis ac pulchris, quæ verbo inter se discrepantia, re prorsus unum videntur sonare, semper tu et nos, ut diligimus, sic utamur,—Christo et Ecclesiæ' atque 'Veritas.'"

In the Inductory Address, Mr. Clifford alludes to certain changes recently made in the constitution of the College—notably, the separation of the College from the State—a change "which has wisely taken from the Legislature and confided to the Alumni of the College, the choice of the Board of Overseers." It has also given the College a greater independence, since it now stands alone, unsupported by the State, and is dependent upon

itself for the maintenance of the position which, as the oldest American University, it ought to occupy. Mr. Clifford then speaks of the power committed to the President, and of the nature and result of his influence upon the Alumni; he advocates a system of "personal examination, by which the Faculty might test the student's disposition to make the best of his opportunities, according to his capacity," in place of the unjust system of arbitrary marks by which mediocrity is too often crushed out by genius. "Mediocrity," he truly remarks, "is the unattractive average of the race; though its capabilities, wisely stimulated and diligently cultivated, constitute the working forces of the world. Genius, with its brilliant, but often erratic efforts, is the rare exception in human endowment. The former needs all the fostering and patient care the teacher can bestow; the latter is self-reliant and sufficient unto itself." When the Fathers of New England who founded Harvard College inscribed VERITAS upon its seal, to which was soon added CHRISTO ET ECCLESIAE, "they surely never dreamed," says Mr. Clifford, "that there is an irrepressible conflict between the truths of ethical and physical science."

Passing now to the address of the new President, let us notice the treatment of matters of faith and reason, considered in regard to an educational system, by a man of great general, and of special scientific culture. The President (and he here speaks also of the University) allows no antagonism between literature and science; he makes no distinction. Instruction is not to be specialised—it is to be general, and the University is not concerned with applications of knowledge: "truth and right are above utility in all realms of thought and action." The subject-matter of learning must be augmented, not diminished. In America specially learning must be broadened and invigorated, for it will require many generations before it will bear pruning. "Recent discussions have added pitifully little to the world's stock of wisdom about the staple of education. Who blows, to-day, such a ringing trumpet-call to the study of language as Luther blew? Hardly a significant word has been added in two centuries to Milton's description of the unprofitable way to study languages. Would any young American learn how to profit by travel, that foolish beginning but excellent sequel to education; he can find no apter advice than Bacon's. The practice of England and America is literally centuries behind the precept of the best thinkers upon education." The problem is not what to teach, but how to teach. With an improved system, Mr. Eliot thinks that a man of twenty-five ought to have a good general knowledge of all the main subjects of human knowledge, and a thorough knowledge of the one subject which is to engage his professional after-life. There are special modes of thought belonging to each special branch of learning, and a young man ought to have some actual experience of each.

As to the subjects taught in the American universities, Mr. Eliot tells us that the course of study has of late been enriched and enlarged. "The University believes in the thorough study of language. It contends for all languages—Oriental, Greek, Latin, Romance, German, and especially for the mother-tongue; seeing in them all one institution, one history, one means of discipline, one department of learning. . . . The University recognises the natural and physical sciences as indispensable branches of education, and has long acted upon this opinion; but . . . the prevailing methods of teaching science, the world over, are, on the whole, less intelligent than the methods of teaching language. The University would have scientific studies in school and college, and professional school develop and discipline those powers of the mind by which science has been created and is daily nourished—the powers of observation, the inductive faculty, the sober imagination, the sincere and proportionate judgment." He next speaks of mathematics, of history, of mental, moral, and political philosophy. The latter of these should not be taught with authority,



because they are full of disputed matters, and because "exposition, not imposition, of opinions is the professor's part."

The admission—or, as we should say, matriculation—examination at Harvard College is something similar to the first examination in the University of Paris; but, for the first degree in Arts, no less than four years' study are requisite. We have another proof of the difficulty of obtaining this degree in the fact that one-fourth of the total number of students who enter the College fail to take it. Of these four years, the first is devoted to certain fixed subjects, through which all fresh men pass; but, during the other three years, more than half the time is given to subjects chosen by the student from lists. Six studies may be thus chosen for the second year, nine for the third year, and eleven for the fourth year of college life. This so-called "elective system" has been found to work well, and President Eliot proposes to extend it. Harvard possesses among her students men of the most varied conditions in life, and of the most varied means. Many men enter yearly without any resources at all; but, so long as they exhibit aptitude for learning, and are of good character, they are never refused admission on account of their poverty. Every year, a sum of more than 20,000 dollars is expended in helping poor students to complete their university education; and, in addition to this, there are many private grants of money. "No capital," says Mr. Eliot, "earns such interest as personal culture. . . . The poverty of scholars is of inestimable worth in this money-getting nation. It maintains the true standards of virtue and honour. The poor friars, not the bishops, saved the church."

Harvard College is governed by the Board of Overseers, the Faculties, and the Corporation. During the last three years, the overseers have been chosen by the Alumni, and five are elected each year to serve for six years. Their duty is to inspect the University, and to watch the actions of the President and Fellows. The Corporation makes all appointments, fixes salaries, and acts as Treasurer. It holds all public trusts and grants, and invests all unemployed moneys of the University. It should always be seeking "how safely to make a quarter of a per cent more: a quarter of one per cent means a new Professorship." The President is a member both of the Board of Overseers and of the Corporation, as, also, of all the Faculties. His chief duty is that of supervision; he has, further, to advise the Corporation in the matter of appointments. As regards the teachers: "the Corporation demands of all its teachers that they be grave, reverent, and high-minded; but it leaves them, like their pupils, free." A University is built, not by a sect, but by a nation.

Here, then, we have, in brief, the outlines of the mode of working of a university "intensely American in affection, and intensely democratic in temper." We can scarcely attempt here so large a scope as a comparison of it with our own or foreign universities, for the character of such an institution is always profoundly influenced by the character and conditions of the people for whom it exists. A strict comparison on equal terms hence becomes impossible, and a comparison, without an even balance of existing influences and qualities, unfair. Yet we would presume to say that many of our European universities might, with advantage, adopt some of the regulations of Harvard; and that a reverse interchange would be beneficial is admitted by the New England Cantabs themselves. Harvard University has grown greatly during this century, and we doubt not but that it is destined to play an important part in the culture of the New World. The new President, whose life has been linked with that of the University, whose judgment has been ripened by travel and by residence in Europe, and who possesses a singularly healthy tone of thought, combined with refined intellectual tastes, has been well chosen for the furtherance of this destiny.

*Geologie Comparée: Etude Mineralogique du fer Météorique de Deesa.* Par M. Stanislas Meunier, Docteur ès Sciences, &c. Paris: F. Savy, 24, Rue Hautefeuille.

THIS pamphlet is a reprint of a series of articles which have appeared in *Cosmos*. The headings of the chapters are:—"Description and Chemical Analysis of the Iron of Deesa;" the latter name refers to a locality in the Cordilleras Mountains, in Chili. "Mineralogical Analysis of the Meteoric Mass;" from this portion we learn that the meteorite referred to contains no less than eleven different well-defined mineralogical species. "Comparison of the Deesa Meteorite with Divers Types of Meteorites." "Conclusions Drawn from the Investigation;" this portion of the paper informs us that it is possible to come to some knowledge of the geological age meteorites belong to, since the author states that our globe contains what he terms eruptive meteoric rocks. The Deesa meteorite is stated to be remarkable, because it is the first instance met with of an extra-terrestrial dyke (*filon*). The pamphlet is well printed, and is issued on a better kind of paper than is usual with our courteous French neighbours.

## CORRESPONDENCE.

### GMELIN'S CHEMISTRY.

*To the Editor of the Chemical News.*

SIR,—In reply to the letter signed "Reference," which appeared in your last number, and for the satisfaction of many persons who are interested in the completion of Gmelin's "Handbook," I beg to be allowed to make the following statement.

About 200 pages of the concluding volume are already translated; but, for the remainder, we have to wait the pleasure of the German editor and publishers, whose movements are not very expeditious. The conclusion was promised last year, but has not yet appeared; when it comes to hand, the translation will be completed with all possible despatch.

The much desired index is in progress, and a considerable portion is already compiled; but its completion must, of course, depend on that of the work itself.—I am, &c.,

HENRY WATTS.

151, King Henry's Road, N.W.  
January 17, 1870.

### PRESENCE OF LEAD IN WINE.

*To the Editor of the Chemical News.*

SIR,—This week's CHEMICAL NEWS contains a paper by Professor Storer, "On the Simultaneous Occurrence of a Soluble Lead Salt, &c., &c., in Sherry Wine." This paper will lead many to believe that the addition of litharge and sulphuric acid to wine is by no means a rare occurrence, and may thus needlessly alarm some, and cast an undeserved slur upon others. I would, therefore, with your permission, make a few remarks on the above paper.

The addition of litharge to wine, for the purpose of removing acidity or for any other purpose, is, I believe, never practised at the present day, if, indeed, it ever was a practice. The belief that such a practice exists is nothing more than an old tradition, kept alive by the occasional finding of lead in some sample of wine.\* In most or all of these cases, when properly investigated, the presence of lead may be proved to result from carelessness, and is not due to wilful addition of litharge for purposes of improvement; indeed, wine could not be thereby improved.

\* Query, Has the name *sugar* of lead, by which acetate of lead is popularly known, anything to do with this belief in the use of litharge as sweetening matter?



For instance, the wine has been run through leaden pipes; has been filled into bottles cleaned with shot, some of which have stuck in the bottle; or has, in some other similar manner, come into contact with lead, and been impregnated by it.

Again, the presence of small quantities of free sulphuric acid is of very frequent occurrence in sherry, and, in fact, in many other wines. Its presence is easily accounted for without the hypothesis of its addition for the purpose of removing lead. It is now well known that plaster-of-Paris is very frequently added to *must*, and its action on cream of tartar yields tartrate of calcium, sulphate of potassium, and sulphuric acid, part of the latter remaining free if the other salts are not sufficient to neutralise it.

Lastly, the solubility of sulphate of lead in tartrate of ammonium is a well-known fact, and has been long employed in analytical chemistry for the purpose of separating sulphate of lead from sulphide of mercury and sulphur.—I am, &c.,

A. DUPRE, Ph.D.

Westminster Hospital,  
January 15, 1870.

### MISCELLANEOUS.

**The Troppmann Trial.**—One of our correspondents has the kindness to call our attention to a portion of the evidence of Prof. F. Rous-sin, which we translate. Speaking of the abdominal viscera of the corpse of Jean Kinck, this well-known chemist says—All the viscera, except the stomach and duodenum, are in full state of putrefaction; the internal parietes of the stomach exhibit a slaty colour, which had not penetrated into the tissue of the organ itself. On more minute examination being made, it was found that there were two distinct colours—one black, due to sulphuret of iron, and one blue, distinctly due to Prussian blue; the latter was detected with certainty, and this was sufficient evidence of the previous presence of hydrocyanic acid. The liquids of the stomach contained, moreover, a very large proportion of an alkaline sulphate, and in such large quantity as it never otherwise occurs in that organ. The Professor accounts for the presence of the three substances named by the rudimentary mode employed by Troppmann for the manufacture of hydrocyanic acid. That method is described as follows:—The convict used two retorts—one smaller, the other larger—the latter serving as receiving condenser. He used ferrocyanide of potassium and dilute sulphuric acid to prepare the hydrocyanic acid from, but was unable to prevent the formation of incrustations of sulphate of potassa and sulphate of iron; hence, irregularity ensued in the boiling of the liquid, and, along with the hydrocyanic acid, sulphate of potassa and sulphate of iron spirted over. In addition to these impurities, there was formed a white substance, which turns blue on exposure to air; and that substance has also been found in the stomach. Some of the Prussian blue found in Kinck's stomach was handed round to the jury at the trial.

### CHEMICAL NOTICES FROM FOREIGN SOURCES.

*Under this heading will be found an encyclopaedic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

*Journal für Praktische Chemie*, No. 15, 1869.

This number contains the following original papers:—

**Some of the Substances met with in the Leaves and Bark of the Cerasus Acida.**—Dr. Rochleder.—In a lengthy memoir, we find the enumeration of a lengthy series of substances partly met with in the leaves, and more especially in the bark, of the tree alluded to. The leaves contain amygdaline, some citric acid, quercitine, and a substance,  $C_{21}H_{20}O_9$ ; the bark contains—phlobaphen, fuscophlobaphen, æscylic acid, rubrophlobaphen, a peculiar tannin, isophloroglucine, and isocaffeic acid.

**Cane Sugar in Madder-Root.**—M. Stein.—The author states that the existence of cane sugar in madder-root has not been hitherto proved. This statement is, however, erroneous, since even about the latter end of the last century attention has been directed to the fact

that madder-root, and especially the Zealand madder, is rich in cane sugar, containing between 14 and 16 per cent. The extraction of this sugar, without interfering with the tinctorial value of madder, and by means different from those whereby that sugar is now utilised—viz., fermentation, and making of alcohol—is not elucidated, only discussed, in this paper. Since some 10,000,000 kilos. of madder are, at the very lowest estimate, consumed annually, and since the bulk of the sugar therein contained is utterly lost, there is a fair field of profitable experimental research still left open and untouched.

**Fermentation Induced by the Microzyma of the Liver.**—M. Kolbe.—320 c.c. of absolute alcohol, 40 grms. of freshly-cut-up sheep's liver, and 16 litres of water, were left standing for five months. The fluid was found to exhibit a very acid reaction, and to give off the odour of sweat. After filtration, the fluid was submitted to distillation, the retort being placed in a chloride of calcium bath, the distillate neutralised with soda, and the alcohol, which had come over unchanged, removed by distillation; the residue, treated with sulphuric acid, yielded capronic and other fatty acids.

No. 16, 1869.

None of the papers of this number are original, and the contents have been abstracted by us already. The death of the chief editor has caused this deviation from the rule; but the publisher states that satisfactory arrangements are being made to obtain original communications.

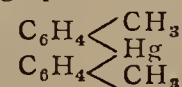
*Zeitschrift für Chemie von Beilstein*, No. 1, 1870.

This number contains the following original papers:—

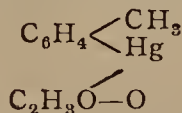
**Behaviour of the Flesh-Coloured Sulphide of Manganese with Various Reagents and at Variable Conditions of Temperature and Pressure.**—M. Muck.—The sulphide of manganese alluded to was submitted, in sealed tubes at from 140° to 150°, to the action of water, sulphuretted hydrogen, hydrosulphuret of ammonium, polysulphide of potassium, ammonia, and caustic potassa solution. No very perceptible reaction was seen with water, sulphuretted hydrogen, and ammonia; with sulphide of potassium, the bulk of the manganese sulphide was left unaltered, but a small portion of the tube was coated with a very firmly-adhering violet precipitate; hydrosulphuret of ammonium caused complete conversion into green sulphide; with caustic potassa, the sulphide of manganese was converted into greyish white hydrated protoxide of the metal.

**Action of Hydrochloric Acid upon Nitrobenzol.**—Dr. Baumhauer.—When concentrated hydrochloric acid and nitrobenzol are heated in sealed tubes to 245° (the tubes often explode), there is found in the tube, after cooling, a crystalline substance, which, on being treated with boiling water, yields hydrochlorate of dichloraniline, some hydrochlorate of aniline, an oily substance difficult to purify, and a solid crystalline matter the nature of which could not be further determined; so that, *summa summarum*, this reaction is, in the main features, similar to the action, under the same conditions, of hydriodic and hydrobromic acids, with this difference—that the temperatures for the two last-named are, respectively, 104° and 185°.

**Contributions from the Chemical Laboratory at Griefswald.**—M. Otto.—A series of papers with the following headings:—On mercurio-diphenyl (a monograph on this subject). Mercurio-ditolyl—



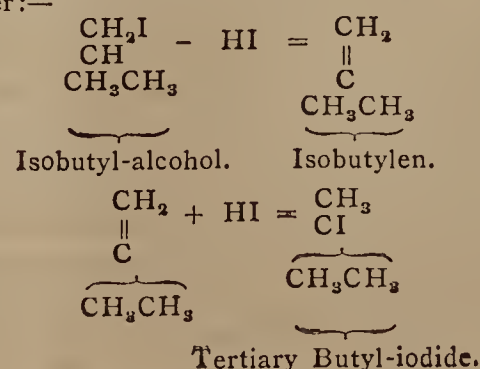
a solid substance, insoluble in water, difficultly soluble in alcohol, and rather more soluble in hot benzol, chloroform, and sulphide of carbon; it fuses at 235°. Mercurio-monotolyl iodide, a solid substance, insoluble in water, difficultly soluble in alcohol, and fusing at 220°. Aceto-mercurio-monotolyl—



a solid, crystallising in rhombic prisms, fusing at 153°, somewhat soluble in boiling water, but better soluble in alcohol and benzol. Behaviour of dibenzyl at a higher temperature (chiefly a series of formulæ). Conversion of this phenol (phenylsulphohydrate) into phenylsulphide. Mercurio-dinaphthyle. Aceto-mercurio-monomethyl and aceto-mercurio-monoethyl. Preparation of organic sulphur compounds by means of hyposulphite of soda.

**Non-Volatile Acids of Croton Oil, and the Non-Existence among them of an Acid  $C_4H_6O_2$ .**—M. Geuther.—A review of the author's labours as compared with those of others on this subject.

**Conversion of Isobutyl-Alcohol into Tertiary Pseudobutyl-Alcohol.**—Dr. Markownikoff.—The reactions are represented in the following manner:—





**Azoxytoluide.**—M. Petrieff.—After briefly stating that M. Jaworski calls azoxytoluide an oil-like substance, the author says—The substance prepared by me from azotoluide by the action of sodium-amalgam is a solid crystalline substance, fusing at 57°, and soluble in ether and alcohol. On being treated with sodium-amalgam, it yields hydrazotoluide.

**Preparation of Aniline-Red without Arsenic.**—M. Coupier.—The author has succeeded in obtaining fuchsine by the action of hydrochloric acid and iron, in small quantities, upon pure aniline and nitrotoluol, taking care to apply a suitable temperature. Commercial aniline and commercial nitrobenzol also yield the same result; and M. Schützenberger states that, having been requested to test the results of this reaction, he has found that the aniline-red obtained is identical with that ordinarily made, and declared it to be a salt of rosaniline. The yield is very fair, and somewhat larger than when arsenic is used.

Cosmos, January 8, 1870.

**Platinum Light.**—M. Schinz.—According to the author's experiments, platinum, made incandescent, and brought to bright white heat by means of the ignition of a mixture of hydrogen and carbonic oxide gases, yields a light which, in relation to good coal-gas, is as 1'24 to 1'0.

**Origin of the Fatty Oil contained in Olives.**—M. Harz.—According to the author's experiments, the results obtained in this investigation are:—The substances secreted in the fruit do not, at its first formation contain any fatty oil. Up to the time of ripening there exist in the fruit, in the state of membranes, undeveloped cells, which become the seat of secretion of the oil, and which membranes may be rendered visible by means of reagents; each of these rudimentary cells contains a very large number of extremely small cells, which, at the time of ripening of the fruit, are converted into fatty oil. The membrane just alluded to may be rendered visible by the successive application of a solution of aniline and chloriodide of zinc, whereby the membrane of the cells which contain a fatty oil assume a beautiful blue colour.

**Discovery of Coals in Algeria and Turkey.**—According to a statement in the *Echo d'Oran*, it appears that there has been found, near Laghouat, an excellent and abundant seam of coal, near the spot where the ancient Romans worked manganese, iron, and zinc mines. As regards the last-named country, M. Hochstetter states that he has found coal near Kézoulik, under the carboniferous limestone on the southern slope of the Balkan mountains.

**Observatory on Mount Ararat.**—The Russian Government have resolved to establish an astronomical and meteorological observatory on this mountain, situated near Tiflis, in consequence of the excellent report given by M. Piazz Smyth of the fitness of such high situations, deduced from his experience on the Pic de Teneriffe.

**Discovery of an Ancient Silver Mine.**—The recent earthquakes in Germany have caused the fall of a large mass of rocks situated between Heidelberg and Wiesloch, and in consequence thereof the works of a silver mine, worked by the ancient Romans, have been brought to light. There is no silver-ore of any importance left, but, instead, a very rich zinc ore is met with in large quantity, which was left untouched by the former workers.

*Polytechnisches Journal von Dingler*, first number for November, 1869.

This number contains the following original papers relating to chemistry or allied sciences:—

**Dioptrical Notices.**—Dr. Pohl.

**Estimation of Sulphur and Gypsum in Animal Charcoal.**—M. Reichardt.—The main feature explained in this paper is, that animal charcoal may, and often does, contain considerable quantities of gypsum; but, besides this, sulphur, apparently in combination with carbon, in a similar manner as sulphur may be met with in coke. The estimation of the sulphate of lime is effected, either by boiling the material under investigation with pure hydrochloric acid, or repeatedly with a solution of pure carbonate of soda. The sulphur is estimated by fusion and ignition of the animal charcoal with pure nitrate of potassa, and in each case the sulphuric acid is estimated in the usual way.

**On Jute.**—Dr. Wiesner.

Second number for November, 1869.

This number contains the following original papers relating to chemistry or allied sciences:—

**On the Various Means of Saving Fuel in the Metallurgical and Technical Applications thereof.**—M. Schinz.—The author discusses, in this memoir, the subject under the following heads:—Increase of the size of the furnaces; decrease of the conductivity of the same; complete combustion; previous heating of air, as well as of fuel; preparation of combustible gases without nitrogen being among the same; highest possible consumption of fuel in a given time; combustion, under increased pressure, of air.

**Newest Shape of M. Wild's Polaristrobometer (Saccharimeter, Diabetometer).**—M. Wild.—Description of a very ingeniously-contrived apparatus, illustrated by a series of engravings.

**Gas for Heating Purposes.**—Dr. Ziurek.—The author states that gas from the brown coal from Furstenwald, five miles from Berlin, will be made on the spot, and collected in Berlin in twelve

gas-holders, each of a capacity of 750,000 cubic feet. The gas will be carried, as usual, in underground mains, and mainly applied for heating purposes. 100 parts of the gas (sp. gr., 0'5451) consist of:—Hydrogen, 42'36; oxide of carbon, 40'00; marsh gas, 11'37; nitrogen, 3'17; carbonic acid, 2'01; condensable hydrocarbons, 1'09. 3000 cubic feet of this gas have a heating power of one-third of a ton of best coals, and are equal to 1 ton of best Prussian brown coal. 1000 cubic feet of this gas will cost about 5d. in Berlin; and the equivalent value of the heating power of this gas, as compared with a ton of coals, will be 4s. 6d. The works have been made to supply 9,500,000,000 cubic feet of gas annually, or at the rate of 2½ millions of cubic feet daily.

**Thymol, a New Disinfectant.**—M. Paquet.—The author proposes the use of thymol, so-called thymianic acid, the stearopten of the essential oil from *Ptychotis ajowan*, an umbelliferous plant growing in India. In undiluted state, this substance is a caustic, and used in dentistry for the cauterisation of hollow teeth; its advantage in this aspect being that it has not an unpleasant taste, and, being very aromatic, does not affect the breath as carbolic acid does. Its aqueous solution is a strong antiseptic and possesses disinfectant properties in a very high degree.

*Bulletin de la Société d'Encouragement pour l'Industrie Nationale*, No. 203, 1869.

This number contains the following original papers and communications relating to chemistry:—

**Injurious Effects of Impure Alcohol upon Aniline Colours.**—Dr. Tillmanns.—The author has examined several varieties of alcohol, and tested the effects upon aniline colours. The most sensitive among these, for impure alcohol, is aniline purple (phenyl-rosaniline). It appears that empyreumatic substances, aldehyde, the peculiar fusel oils due to the substances used in the manufacture of the alcohol—viz., grain (malted or raw), potatoes, the refuse of beet-root sugar manufacture—affect the aniline colours when dissolved in such alcohols and boiled therewith. The best test for the purity of an alcohol is to dissolve in it 1 per cent of perfectly pure caustic potassa, and to heat the solution; it should only acquire a bright yellow colour. Another test is to dissolve 1 part of the aniline purple alluded to in 50 parts of the alcohol to be tested, and to heat the fluid for some time. If, after half-an-hour's heating, no change is observed, the quality of the alcohol is good; but if the latter is not pure enough, the mixture soon becomes turbid, and assumes a red colour. Aldehyde is often present in alcohol, especially if it has been purified by means of charcoal.

*Moniteur Scientifique*, No. 313, January 1, 1870.

This number opens with a full and lengthy account of the proceedings taken by the Ministère Public of the Tribunal Correctionnel de Paris in re the explosion of the 16th of June last on the Place de la Sorbonne, caused by picrate of potassa. From the scientific, as well as other evidence given about the danger of picrate of potassa (several artillery officers and the Director of the Pyrotechnic School at Toulon having been examined), it appears that the substance alluded to is, as might be expected, far less to be feared than gunpowder, gun-cotton, and salts of fulminic acid. The accused, M. Fontaine, was fully acquitted, in every respect, of the charges made against him of having caused manslaughter by imprudence.

**Artificial Porphyry.**—MM. Sepulchre and Ohresser.—It appears that the authors have perfectly succeeded in utilising the slag of the iron blast furnaces for the manufacture of paving-stones, which withstand a crushing weight of more than 400 kilos. per square centim., and have answered for the purpose of paving several streets at Brussels and Paris, and stood heavy traffic far better than even the celebrated Quenast stones. The streets paved with this material at Brussels have a heavy gradient.

**Lignite from Vescovado, Province of Sienna, Italy.**—M. Kopp.—At only eight metres under the surface of the soil, is found a layer of lignite of 3'5 metres thickness. This substance, having been submitted to analysis, yielded, on being dried at 115°, 21'80 per cent of water. On being calcined in a closed crucible, 100 parts gave:—Volatile combustible matter, 26'48; fixed carbon, 42'52; ash, 9'20; water, 21'80. When submitted to dry distillation in a gas retort, acetic acid is among the products, and 51 per cent of coke; the quantity of sulphur amounts to 1'36 per cent. 1 kilo. of lignite is capable, on combustion, of evaporating 6'1 litres of water. Since there is no coal found in any part of Italy, as far, at least, as it has been explored, this material is of considerable value to the industry of that country.

**Artificial Alizarine.**—MM. Meister and Lucius.—These gentlemen write to the editor of the above-named periodical in reference to what was stated about their invention, and abstracted by us (see *CHEMICAL NEWS*, vol. xx., p. 299), and, denying the truth and correctness of what is there given, now explain that they legally deposited the secret of their mode of manufacture with the Burgomaster of Hoechst (Prussia), and that, consequently, legal proof can be given, both as to their peculiar process and as regards priority. They also state that the first samples made were not quite satisfactory, but that now they are in full swing, and have such an increased demand for their produce as to render it impossible for them to serve their customers immediately, they having to wait till their turn comes.

**Detection of Fixed Fatty Oils obtained from the Seeds of Cruciferae.**—M. Gréhaut.—Some fatty oils, especially those obtained from the *Cruciferae* (colza, rape, cameline, mustard), naturally contain sulphur. This may serve for the detection of these oils by boiling



some 25 grms. of the same with an aqueous solution of 2 grms. of caustic potassa in 20 grms. of water. When the mixture is poured on to a previously-moistened filter, the filtrate will blacken paper soaked in acetate of lead or nitrate of silver; and, on addition of some hydrochloric or sulphuric acids, sulphuretted hydrogen is given off, easily recognised by the smell. Linseed, nut, sesame, or ground-nut oils, do not contain sulphur, and do not, consequently, give rise to this phenomenon, if treated in the same manner. The experiment is best performed in a clean bright silver capsule, which, of course, becomes at once brown- or black-coloured, owing to the formation of sulphide of silver in a more or less degree.

*Revue Hebdomadaire de Chimie*, January 6, 1870.

**Manufacture of Soda by the Use of Strontia and Ammonia.**—M. Ungerer.—When, to a concentrated solution of sulphate of ammonia, is added an equivalent quantity of chloride of sodium, and the fluid heated to boiling-point, mutual decomposition of these salts takes place, and sulphate of soda and chloride of ammonium is formed; the former salt separates as a crystalline powder, and may be removed by filtration from the solution of the chloride of ammonium. The sulphate of soda, having been dissolved in water, may be decomposed by caustic strontia, thus yielding caustic soda; the chloride of ammonium may be converted into carbonate of ammonia by means of chalk. It is doubtful whether this process, theoretically correct, will be commercially available.

**Bleaching of Fixed Fatty Oils.**—M. Diéterich.—Into a wooden tub, provided with a properly-constructed tap at the bottom, are poured 30 litres of water, wherein 1 kilo. of permanganate of potassa is dissolved. To this mixture is added 50 litres of the oil to be bleached, and the fluids well stirred up for about two days; at the end of that time, 20 litres of boiling water and 5 kilos. of commercial hydrochloric acid are added; the liquid is again well stirred up; and, after two more days, the acid liquor is run off by means of the tap, and, having been removed, the oil is repeatedly washed with boiling water, until all the acid is removed from it.

**Beer-Yeast as a Manure.**—M. Bernier.—Beer-yeast contains from 7 to 11 per cent of nitrogen; it is easily decomposed—in common parlance, soon rotten. The author mixes 100 kilos. of it with 30 kilos. of slaked lime and 10 kilos. of gypsum, and thus obtains a pulverulent substance, which may be applied in agriculture instead of guano. It is well-known that, especially in summer, large quantities of this yeast are run off into sewers and altogether wasted.

*Les Mondes*, January 6, 1870.

This number contains the following original paper:—

**Instantaneous Production of Artificial Precious Stones.**—M. Zchweskofski.—Many of our readers have seen that the ordinary newspapers have communicated some more or less sensational accounts concerning the instantaneous artificial preparation of precious stones. It appears that the author has discovered some peculiar silicic and aluminous ethers; but it is not true that these yield, on evaporation, precious stones, and certainly no diamonds, as reported by some newspapers, whose editors do not seem to know what diamonds are. Altogether, the communication (excepting the discovery of the ethers above alluded to) is a *canard*.

January 13, 1870.

**Aurora Borealis Seen at Nantes.**—L'Abbé Trébeden writes, that on the 3rd inst., at  $\frac{1}{4}$  past 6 p.m. (local time) he observed a brilliant aurora borealis which occupied an arc of  $70^\circ$  of the horizon, and extended some  $20^\circ$  in height. The temperature of the air was at that moment  $7.1^\circ$ , and the reading of the barometer 768 m.m. The phenomenon lasted fully an hour, perhaps longer; but it became invisible on account of clouds coming up. The city of Nantes is situated about  $46^\circ$  N. latitude.

**On the Nascent State.**—M. St. Claire-Deville.—This paper is the first of a series which the author intends to publish in this periodical on a subject which cannot be well rendered in extract. We intend to return to this subject.

**Influence of the Phases of the Moon upon the Height of the Barometer.**—M. Coloria.—The result arrived at is that there does not exist any definite relation between the height of the barometer and the synodic revolutions of the moon.

**Action of Tobacco and Effects of Smoking upon the System.**—Dr. Séc.

## NOTES AND QUERIES.

**Detection of Opium in Tobacco.**—(Reply to E. Morton.)—Make an infusion of the cigars in water slightly acidulated with acetic acid. Filter, and add basic acetate of lead till all the colouring matter is nearly precipitated; again filter and digest during a whole day with a little animal charcoal. Collect the charcoal, and boil it in alcohol twice or three times, using altogether about a pint of that solvent. Evaporate this solution to dryness on a water-bath, and treat the extract, first with water rendered freely alkaline by ammonia, then with ether, and lastly with alcohol; this is now evaporated, and the residue

tested for morphia as usual. 0.02 grms. of opium may be detected by this process in a single cigar.—JOHN MUTER, Ph.D.

**Detection of Opium in Tobacco.**—(Reply to E. Morton.)—Although it is hardly likely ever to occur that tobacco should be adulterated with opium, the latter substance might be detected by the reactions of meconic acid. Opium does not burn well at all; neither does the *tandoo* (i.e., its aqueous and inspissated extract) do so, for it is a well-known fact that opium smokers can only keep the small quantity they use alight by means of the aid of a spirit-lamp, or by means of an addition of some easily-burning substance to the extract. Moreover, opium is too expensive a drug to adulterate tobacco with, and those who use opium (as, unfortunately, too many do in this country) employ it in a pure state.

**Fancy Colouring of Metals.**—The colouring matter of small objects in metal has recently occupied the attention of manufacturers and chemists, and M. Pushec, a German chemist, gives the following recipes for the application of sulphur to the purposes referred to:—(1) A solution is made in the following manner:—Dissolve 4 ozs. of the hyposulphite of soda in  $1\frac{1}{2}$  pints of water, and then add a solution of 1 oz. of acetate of lead in the same quantity of water. Articles to be coloured are placed in the mixture, which is then gradually heated to boiling-point. The effect of this solution is to give iron the effect of blue steel; zinc becomes bronze; and copper or brass becomes successively yellowish, red, scarlet, deep blue, light blue, bluish white, and, finally, white, with a tinge of rose. This solution has no effect on lead or tin.—(2) By replacing the acetate of lead in the solution by sulphate of copper, brass becomes first of a fine rosy tint, then green, and finally of an iridescent brown colour. Zinc does not colour in this solution—it throws down a precipitate of brown sulphuret of copper; but if boiled in a solution containing both lead and copper, it becomes covered with a black adherent crust, which may be improved by a thin coating of wax.—(3) If the lead solution be thickened with a little gum tragacanth, and patterns be traced with it on brass, which is afterwards heated to  $212^\circ$ , and then plunged in solution No. 1, a good marked effect is produced.

## MEETINGS FOR THE WEEK.

MONDAY, 24th.—Medical, 8.

— Geographical, 8.30.

— London Institution, 4.

TUESDAY, 25th.—Royal Institution, 3. Prof. Humphry, "On the Architecture of the Human Body."

— Institution of Civil Engineers, 8.

— Ethnological, 8.

WEDNESDAY, 26th.—Society of Arts, 8.

— Geological, 8.

THURSDAY, 27th.—Royal Institution, 3. Prof. Odling, "On the Chemistry of Vegetable Products."

— London Institution, 7.30.

— Royal, 8.30.

— Zoological, 8.30.

FRIDAY, 28th.—Royal Institution, 8. Prof. Odling, "Graham's Scientific Work."

— Quekett Club, 8.

Saturday, 22nd.—Royal Institution, 3. Mr. Scott, "On Meteorology."

## TO CORRESPONDENTS.

\*.\* Vol. XX. of THE CHEMICAL NEWS, containing a copious index, is now ready, price 11s. 4d., by post, 11s. 10d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our office, or, if accompanied by a cloth case, for 1s. Subscribers wishing to complete their sets of volumes are requested to apply to the publisher, who will give them information respecting scarce numbers and volumes. Vol. xxi. commenced on January 7th, and will be complete in twenty-six numbers.

R. Reynolds.—Received, with thanks.

A. Hedley.—Dr. Lunge, of South Shields, will be able to give you full information about the use of aluminate of soda in soap making.

J. Watkins.—To prepare hydrochlorate of aniline and tartrate of aniline you must saturate aqueous solutions of the respective acids with aniline.

C. P. Bahin and others.—You will see the explanation on the front page of the present number.

J. T. Thompson.—A work by Dr. Letheby, "On Food," is just published by Messrs. Longmans.

Prof. J. Laurence Smith (Louisville).—Your letter and enclosure have been received, and shall be attended to. The Photometer invented by the Editor is manufactured by Messrs. Elliott and Co., of Charing Cross, London.

## BOOKS RECEIVED.

Rinderpest: its Prevention and Cure, and Gypsum as a Sanitary Agent. Edinburgh: William P. Nimmo. London: Simpkin and Co.

On the Ozonimeter for the Observation of Ozone with an Aspirator; Instructions for its Use, and the Results obtained. By John Smyth, jun., M.A., F.M.S., &c. (From the Author.)



# THE CHEMICAL NEWS.

VOL. XXI. No. 531.

## NOTES FROM THE LABORATORY OF A

### SUGAR REFINERY.

By WILLIAM ARNOT, F.C.S.

(Continued from p. 26.)

#### VII. M. GASTON TISSANDIER'S METHOD OF ANALYSING ANIMAL BLACK.

WHEN the author of these notes penned that immediately preceding this, he little thought that it was at all necessary to go into the details of the process of analysis, but contented himself by simply throwing out a hint or two upon the subject; the simultaneous appearance of M. G. Tissandier's notes upon animal black with his own has, however, shown him his mistake. The methods recommended by that gentleman are so faulty as to demand some special remark.

1. *The Carbon*.—M. G. Tissandier arrives at the proportion of this most important agent by a method which cannot be relied upon. The writer at one time thought that he had made a great time-saving discovery, when the idea of doing as M. G. Tissandier recommends struck him, but he soon found out his mistake: the difference between the "ash" and the original weight *does not* give the carbon and moisture. To whatever cause it may be due, the results obtained by this process always differ from those obtained by the more trustworthy method hereafter to be described. Two objections to M. G. Tissandier's process may be pointed out—There is always iron present in animal black, and, as indicated in the preceding note, it always exists as protoxide; this is, of course, peroxidised by M. G. Tissandier's process. The carbonates are liable to decomposition, and though caution, during the process of calcination, is recommended, the manipulator has no guarantee that he has not decomposed a portion of them; and to moisten with ammonium carbonate, as recommended by Dr. Wallace, is not at all safe. The analysis should always be made upon the dried sample—the moisture may, of course, be estimated in the usual way, in a portion (several hundred grains) of the original *unground* sample; but, with working chars, unless the sample is for sale, the moisture may be left out altogether. It may be necessary to state, as a reason for estimating the moisture in the original char in preference to the pulverised, that in the process of grinding, which occupies some time, the char, if comparatively dry, is liable to absorb moisture from the atmosphere. 50 grs. of the sample, in impalpable powder (which *should not* be sifted, but the whole reduced uniformly to the necessary fineness, the hard gritty grains which so persistently resist the action of the mortar and pestle sometimes, have usually a different composition from the softer portions, and ought not to be rejected, as M. G. Tissandier recommends), are boiled in dilute hydric chloride; twenty minutes are usually necessary to accomplish this satisfactorily. The insoluble is thrown upon a weighed filter, and very thoroughly washed; the filter, after drying, is weighed—the difference being carbon and sand. The drying and weighing must be very carefully attended to; after the first weighing, the filter should be returned to the drying oven, and after a time weighed again, and so on until the results are constant. The filter is then ignited, the residue being sand and clay; the weight of this, deducted from the previous result, will, of course, give the

carbon, and that accurately. The carbon being a most, if not the most, important element in the char, its accurate determination must be made a point in the analysis.

2. *The Silica* by M. G. Tissandier's process will be found much too high; "water acidulated with chlorhydric acid," "slightly heated," will scarcely have the desired effect upon ignited "ash." The twenty minutes' boiling with moderately strong acid, referred to above, will be no more than competent to do the work indicated, but from the preceding remarks it will be seen that the sand, &c., can be got at otherwise.

3. *The Phosphates*.—It seems passing strange that the system of precipitation by ammonia should again require to be publicly protested against. The results by this process are worth nothing; and how, otherwise than by accident, an analysis can be got to come to 100 when it has been employed the writer cannot guess. Perhaps if M. G. Tissandier had been asked to reconcile the phosphate results of different analysts (as the writer has been), he would long ere this have consigned the process to oblivion. Better leave the phosphates alone altogether than precipitate them by ammonia; the analysis will more likely be correct. Precipitation as ammonio-magnesian phosphate will, with care, give reasonably-accurate results.

4. *The Carbonates* must not depend upon the lime left over in the solution after the separation of the phosphates: many errors creep in here. The total lime should be estimated by precipitating with oxalate of ammonia, as a check upon the other results; but the carbonic acid itself must be the guide to the amount of carbonates. One process for carbonic acid has already been referred to with favour. In the absence of Dr. Schiebler's apparatus, however, some of the usual gravimetric methods admitting of the use of hydric chloride may be employed.

5. M. G. Tissandier makes no mention of iron in his analysis. He may be dealing all alone with new, unused char, in which the iron is usually very trifling; but he does not say so. The iron is an essential point in the analysis of used chars, and is not to be passed lightly over even in new, unused chars. As already indicated, its estimation may be accurately made by Penny's process. The strength of the bichromate solution best adapted for the delicate operation is 2.75 grs. of the pure and dry salt to 1000 grs. of water; in which case the alkalimetric measures consumed will be divided by 16 to give percentage of metallic iron—*i.e.*, supposing 100 grs. of the char to have been used. The process must be conducted neatly and rapidly, as the solution is liable to absorb oxygen from the atmosphere.

M. G. Tissandier concludes this part of his paper by appending the results of the analysis of three samples of char. The writer has seen and executed several hundred analyses of this agent, and never, in all his experience, has he met with more extraordinary results than those given by M. G. Tissandier, as illustrative of the composition of this substance (?). Are these the analyses of new chars, or old? Have they been used in the "beet" manufacture, or in connection with some special process? Where is the iron, and the sulphates? For what object are the results published? Without some information upon these points, they can only mislead the reader.

M. G. Tissandier's method of estimating the decolourative power of chars is very pretty, but of no practical value. The results will express *the relative power of pulverised animal-black to decolourise caramel*; but that is not what the sugar refiner requires. For sugar-refining purposes, nothing but sugar-refining methods of testing decolourative powers will do. The author has tried many devices, both with grain and pulverised char, with log-wood decoction, caramel, &c.; but the results in no case give the true value of the char to the refiner. The directions given in Note V. have been followed, with the most satisfactory results, for three years. During that time, several other *simpler* systems have been tried; but all have had to give way to the *more tedious, but accurate*, system described.



## ON MICROSCOPICAL MANIPULATION.\*

By W. T. SUFFOLK, F.R.M.S.

(Continued from p. 31).

INTIMATELY connected with microscopical drawing is the subject of micrometry, the practice of the two together forming the records and statistics of histological science. The contrivances used by the earlier observers were rude in the extreme. Leeuwenhoek compares the dimensions of magnified objects with grains of sand. Dr. Hooke, with a little more approach to exactness, used fine silver-wire. By winding a quantity of this closely round a thicker wire, he noticed how many coils there were in an inch, and used the unit so obtained as a means of measurement. The most perfect of the old micrometers is a somewhat complicated contrivance attached to a microscope by the famous Benjamin Martin, now in the possession of the Royal Microscopical Society. It consists of a separate stage, which is placed on the instrument when measurements are required to be taken. The object is capable of being moved through a definite space, by means of delicate screws, having large graduated heads, upon which the distance traversed by the object can be read off. This micrometer has, in common with all measuring instruments applied to the stage, the defect that any error in the graduation is multiplied by the whole magnifying power of the instrument.

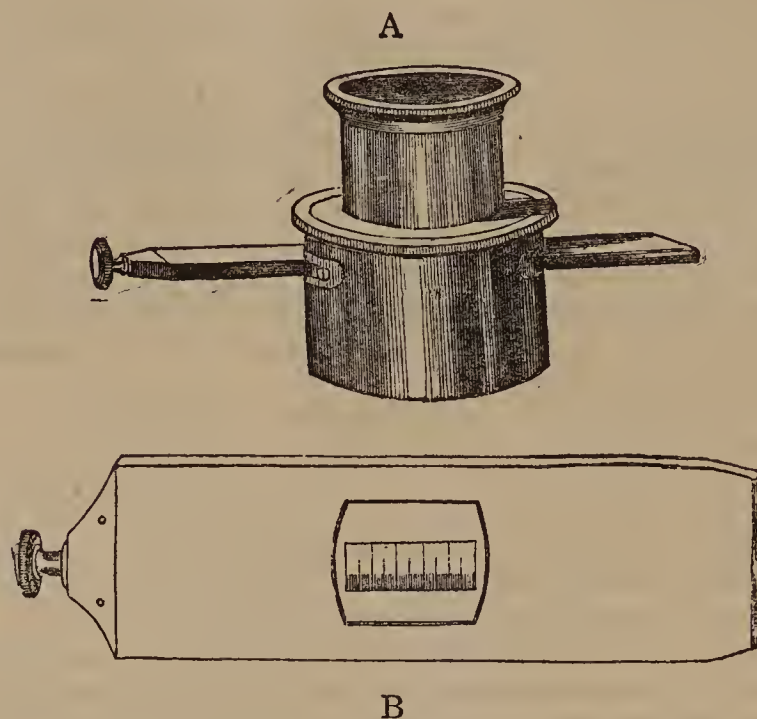
The standards employed in microscopic measurements are the ruled slips of glass before mentioned. They are graduated by a machine invented by the late George Jackson, and are now to be obtained of most opticians. They are ruled in hundredths and thousandths of an inch, and are marvellously accurate in their divisions, and extremely fine in the engraving of the lines, bearing a very high magnifying power without appearing coarse. Scales are also ruled in millimetres. The millimetre equals 0.03937 English inches, or about 1.25th of an inch. As the metric system will probably in a few years be universally adopted, it is well to place both scales on microscopical drawings, especially as this system of measurement is common on the Continent.

One method of measurement has already been mentioned in describing the use of the camera lucida.

To obtain the greatest degree of accuracy in microscopical measurements, it is desirable that, while the object to be measured is magnified as much as possible, the measuring scale should be but slightly enlarged. This is effected by the use of eye-piece micrometers. The most delicate of these is the well-known *cobweb micrometer* of Ramsden. It is nearly similar to that employed in astronomical instruments, and consists of a positive or Ramsden's eye-piece, in the focus of which is placed a pair of stretched cobweb-lines, one of which is fixed, and the other movable by means of a fine screw which has a large graduated head. The value of the graduations has to be determined for each object-glass, as is the case with all similar contrivances. The cobweb micrometer, when used with a sufficiently high power, is capable of measuring extremely small portions of space with great exactness; the instrument, however, is rather expensive.

With a view to avoid the multiplication of apparatus, the late George Jackson, by a simple contrivance, rendered the ordinary Huyghenian eye-piece available for micrometric purposes. A slit was cut on each side just above the diaphragm (Fig. 43 A), which served to admit a brass slide, B, containing a scale ruled on glass, which, when in position, was in the focus of the eye-glass, and could be seen in the field at the same time with the object in the microscope. The scale is ruled with a long line at every fifth division, and a still longer one at every tenth, for facility of reading. The scale is allowed a small amount of lateral motion, which is controlled by a fine screw acting against a spring on the opposite

FIG. 43.



side. This movement enables the line from which the measurement commences to be brought to the edge of the object more accurately than it could be by means of the stage movements, as the scale of the eye-piece micrometer is only magnified by the trifling power of the eye-glass, while the motion of the stage-racks is enlarged by the whole power of the instrument. The operation of measuring is nearly as easy as applying an ordinary rule: the scale is brought over the object, adjusted by the screw, and the number of degrees read off in the direction required.

To determine the value of the degrees, which differs with each objective, the following process must be adopted:—

Place the micrometer in its eye-piece, and focus, if necessary, for distinct vision of the scale by unscrewing the eye-glass, which is usually provided with a rather long screw for this purpose. Screw on the objective, and place the ruled scale on the stage; and, looking through the microscope, focus until the lines are sharp and distinct. Suppose the value of the micrometer is to be ascertained for the  $\frac{3}{4}$  object-glass, and it is found that 1.1000th of an inch of the ruled scale on the stage occupies a little less than two divisions of the micrometer, this will give an awkward number for calculation; so it will be necessary to increase the power of the microscope to such an extent that the 1.1000th should occupy 2° exactly. This can be done by lengthening the body by means of the draw-tube, which, for this purpose, should be divided into inches and tenths, that the amount of extension may be noted. The tube is to be drawn out until the divisions of the stage micrometer coincide

\* The substance of a course of lectures delivered to the members of the Quekett Microscopical Club, January—April, 1869.



with those of the eye-piece micrometer. Say, for example, it is found that, to effect this, the tube has to be lengthened 3-10ths of an inch; then, as 1-1000th of an inch equals 2° of the eye-piece micrometer, 1° is equal to 1-2000th of an inch. This process should be repeated with each object-glass, and tried several times, to ensure accuracy. The result should be preserved in the following tabular form:—

VALUE OF DIVISIONS OF EYE-PIECE MICROMETER.

Objective.	Draw-tube.	Vulgar Fraction.	Decimal.
$1\frac{1}{2}$	13	$\frac{1}{1000}$	·001
$\frac{2}{3}$	3	$\frac{1}{2000}$	·0005
$\frac{4}{10}$	22	$\frac{1}{4000}$	·00025

And so on through the whole series of objectives. The slight alteration of distance between the anterior combination and the back lenses caused by turning the graduated collar which regulates the adjustment for covering glass with the higher powers, slightly alters the magnifying power; and, when very accurate measurements are required, the draw-tube correction must be ascertained for each degree of the adjustment-collar. The value of the divisions of the Ramsden's or cobweb micrometer is calculated in the same manner. When this table is once made, measurement with the eye-piece micrometer becomes very easy indeed. After selecting the object-glass and placing the micrometer in the eye-piece, draw out the tube. The number of tenths indicated in the table, and then the degrees, can be read off just like an ordinary measure. To secure accuracy in measuring, always use the highest convenient magnifying power, as the readings can be made with greater minuteness; for instance, a degree with the 4-10th or  $\frac{1}{2}$  equals 1-4000th of an inch; while, with the  $\frac{1}{3}$ , it would be 1-16000th, and half a degree can easily be estimated by the eye; so, by using the higher power, the 1-32000th of an inch can easily be measured, and greater minuteness still can be obtained by using higher powers, where practicable.

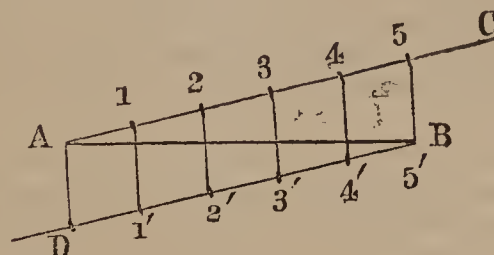
A convenient mode of measurement has been devised by Dr. J. Matthews. It is an adaptation of the indicator, sometimes placed in the eye-piece to mark a spot in the field. Two of these pointing needles, suitably curved so that they act, by means of milled-heads, like a small pair of callipers, are placed as just mentioned. The distance on the object is measured between these points, and, upon the removal of the slide, the value of the space can be estimated by putting the stage micrometer in its place. For counting striæ and other marks in a given space, and for many purposes, this simple contrivance is very effective, as, also, where the glass of the stage micrometer might interfere with the definition of a very delicate object.

In making the scales on microscopical drawings, it is often necessary to divide a given space into a certain number of equal parts. When the number is a multiple of two, it is readily performed by a continued process of bisection; but, as ten is a number frequently required, this process will not serve beyond the first bisection, which leaves five—a rather troublesome number to guess at with the compasses. Suppose the line A, B (Fig. 44) is to be divided into five parts. From A, rule the line A, C at any convenient angle, of any suitable length; from B, rule B, D parallel to A, C; from A, set off, with the compasses, five equal spaces (1, 2, &c.) towards C; and, from B, set off the same towards D; join

1, 1'; 2, 2'; 3, 3'; &c.; and the lines 1, 1', &c., will divide A, B into five equal parts. Any number of divisions may be made by setting off the number required on A, C and B, D.

If scales are employed for setting off distances, those known as "feather-edged scales" are to be preferred, as they do not require the use of compasses, the divisions being marked directly on the

FIG. 44.



paper from the thin edges. For general purposes, that known as a builder's scale is convenient, as it contains a large number of different scales, all of which are ingeniously contrived to read at the edges. It should, however, have the sub-divisions in tenths, and not, as usually made, in twelfths. A millimetre scale will also be found useful.

(To be continued.)

## NEW METHOD FOR THE SEPARATION OF THE PLATINUM METALS\*.

By Professor BUNSEN.

IN the metallurgic process of extracting platinum from its ores, there are obtained three products, which are admirably adapted for obtaining those rare metals which constantly accompany this metal. These products are:—

1. The "Ore residues," which remain behind after the mass of platinum, &c., has been extracted by aqua regia; these are rich in osmium and iridium, hence best adapted to the purpose of extracting these metals.

2. "Osmiridium," obtained, by mechanical washing, from the first residue, and which is best adapted for obtaining ruthenium.

3. The "Mother-Liquid Residues," left behind in the aqua regia solutions after reduction with iron, the platinum having previously been separated (with chloride of potassium?). These are rich in palladium and rhodium, and are the best for obtaining these metals.

The following researches were made with a material of the last sort; for each separation, 1 kilo. of residue was used.

The residue contains, with the exception of osmium, all the platinum metals, and is particularly interesting on account of its relatively great richness in rhodium.

Claus's mode of separation (the only one previous to this) involves the loss of much valuable material. To separate the rhodium from iridium, Claus used the old method proposed by Wollaston, which depends upon the solubility of the ammonium (or potassium) double salt of sesquichloride of rhodium in chloride of ammonium. The fact, however, that the salt  $KCl, IrCl_2$ , is taken up in considerable quantity by a solution of chloride of ammonium (or chloride of potassium) saturated with a rhodium double salt, a fact of which I have repeatedly convinced myself, is sufficient to awake the gravest doubts as to whether the metal given out to be rhodium, and to which Berzelius and Claus ascribed the atomic weight = 52, did not contain considerable quantities of iridium. I found it, there-

\* Translated from his late contribution to the *Annalen der Chemie und Pharmacie*, entitled "Ueber das Rhodium," by W. H. Wahl. Communicated by Professor Morton, editor of the *Journal of the Franklin Institute*.



fore, necessary to leave the beaten track, and to search for a more exact method of separation.

#### SEPARATION OF PLATINUM AND PALLADIUM FROM THE OTHER METALS OF THE GROUP.

The complete separation of rhodium, iridium, and ruthenium from platinum and palladium, by digestion with aqua regia, will not succeed with these questionable residues, as considerable quantities of the first-named metals are present in the form of hydrated sesquioxides, and partly present in a most finely-divided state, and in consequence, dissolve with the platinum and palladium; without taking into consideration the fact that the residue left behind by this digestion is only filtered with infinite difficulty.

On the other hand, it is easy to effect the separation of platinum and palladium from the others, almost completely, if the original material is mixed in a Hessian crucible with from  $\frac{1}{2}$  to  $\frac{3}{4}$  its weight of chloride of ammonium, heated until the latter is completely volatilised, allowed to glow gently until only the vapours of sesquichloride of iron show themselves, and then placed in a porcelain dish and evaporated to a syrupy consistency with from two to three times its weight of raw commercial nitric acid. By this treatment with chloride of ammonium, the metals present not belonging to the platinum group will have been partially converted to *lower chlorides*; rhodium, iridium, and ruthenium will have been rendered insoluble, and the silica, present as gangue, converted from a gelatinous mass to a finely-pulverulent condition, in which state it will admit of speedy filtering.

The chlorine compounds, produced by the chloride of ammonium, give us, upon digestion with nitric acid, just enough hydrochloric acid to dissolve the platinum to bichloride, while the metallic copper and iron present act in so far reducing upon the palladium (in solution in nitric acid) that it remains in solution, not as bichloride ( $\text{PdCl}_2$ ), but as the protochloride ( $\text{PdCl}$ ), which latter is not precipitated with chloride of potassium. The mass is diluted with water, filtered, and the solution saturated with chloride of potassium, and the greater part of the platinum separated pure as  $\text{KCl}, \text{PtCl}_2$ , which is washed out, first with chloride of potassium, and later with absolute alcohol (the last washings must not be added to the solution). This precipitate weighed 62 grms.

The filtrate is brought into a large flask (which can be made air-tight) which will not be more than half-filled with it. Chlorine gas is led into this flask, and the same is, from time to time, shaken vigorously until no further absorption of gas takes place, when all the palladium will have separated as a cinnabar-red precipitate of  $\text{KCl}, \text{PdCl}_2$  (somewhat impure, however, from traces of platinum, iridium, and rhodium). This precipitate weighed 157 grms. The fluid from which these precipitates were obtained is now evaporated, not quite to dryness, with hydrochloric acid; and, upon addition of *just so much water as was necessary* to dissolve out the chloride of potassium and other soluble salts (aiding the operation by rubbing with a pestle), there remained behind a dirty, yellow-coloured precipitate. This was separated by filtration, boiled with caustic soda and a few drops of absolute alcohol. Hydrochloric acid was added to dissolve the precipitate formed, and the liquid then saturated with chloride of potassium. result was a precipitate of 13.5 grms. of chemically-pure  $\text{KCl}, \text{PtCl}_2$ . The mother liquid contained only copper, and no platinum metals.

The purification of the cinnabar-red precipitate of palladium was accomplished as follows:—It was dissolved in boiling water, whereby a portion of the chloride dissolves, with evolution of chlorine, to  $\text{PdCl}$ . It was then evaporated with 60 grms. of oxalic acid, and dissolved again in a solution of chloride of potassium; whereupon 42 grms. of  $\text{KCl}, \text{PtCl}_2$  remained behind, which, upon testing, proved chemically pure. It was washed out as before.

The brown liquid was then somewhat concentrated upon the water-bath; and, upon cooling, there separated 19 grms. of bright green, well-formed crystals of  $\text{KCl}, \text{PdCl}$  (with some chloride of potassium), which, upon testing, likewise proved free from the other platinum metals.

The fluid poured off from these crystals was then neutralised carefully with caustic soda, and gave a very slight precipitate of copper and iron, which was filtered off. Upon adding iodide of potassium to the filtrate, all the palladium separated as  $\text{PdI}$ . To avoid adding an excess of the reagent, it is best to take, from time to time, a drop from the fluid with a capillary tube, and bring the same upon a watch-glass. As long as the precipitation is incomplete, the drop appears, upon a white background, *brown*; when complete, it is *colourless*; when the reagent is present in excess, it is *red*. This weighed 77 grms., and was tested for its purity by reducing it to metallic palladium, and then heating and dissolving in nitric acid; when pure, it must dissolve completely. The whole mass was now reduced in a slow stream of hydrogen gas (whereby the iodine can be obtained again, as hydriodic acid, by absorbing with water). At last, the mass must be strongly heated, to decompose slight traces of the subiodide of palladium ( $\text{Pd}_2\text{I}$ ) which are formed.

The mother liquid from which all this platinum and palladium has been obtained may contain some iridium and rhodium; it is, therefore, evaporated to dryness with a little iodide of potassium, whereby a mixture of the iodides of rhodium and iridium separates. This can either be dissolved in aqua regia and the two metals separated (as will hereafter be described) by the bisulphite of soda, or it can be united with the portion from which these metals will be obtained.

#### SEPARATION OF RUTHENIUM, AND OF RHODIUM AND IRIDIUM.

The residue from 1 kilo. of the original material which remained, after treatment with chloride of ammonium and nitric acid, weighed 400 grms. It was treated as follows, to get the metals in a form adapted to further chemical treatment.

The method depends upon the behaviour of chloride of zinc to zinc. If a piece of zinc be smelted, it rapidly covers itself with a stratum of oxide. If, to the smelted metal, a metal like iridium be added, the oxide stratum hinders the latter from coming into contact with the zinc, even though it be pushed beneath the surface. If, however, a few grains of chloride of ammonium be given to it, ammonia, hydrogen, and chloride of zinc will be formed, which last dissolves the oxide stratum to basic chloride of zinc. The zinc below resembles mercury in lustre and movability. As soon as the chloride has dissolved as much of the oxide as is possible for it, the oxide stratum again forms, and is instantly removed again by the addition of more chloride of ammonium. The melted zinc, strewn with chloride of ammonium, also possesses, like mercury, the property of attacking other metals, if the affinity exists of forming with them alloys. By strewing chloride of ammonium upon the melted zinc, a quiet surging is kept up as the ammonia and hydrogen are given off. Many oxides and chlorides (among which are those of the platinum metals) are, when they come into contact with this atmosphere of reducing gases, and with the basic chloride of zinc, instantly reduced and dissolved to alloys by the zinc. [We have here a means of separating quantitatively all metals which are not dissolved by zinc from those which are.] In making the solution, the zinc, in a porcelain dish, should be constantly rotated: the gangue remains in the basic chloride. The regulus, immediately upon solidifying, should be taken from the capsule, out of the yet-fluid basic chloride, and washed off with acetic acid until all the basic chloride is dissolved away. The gangue can be quantitatively determined by filtration and weighing. If the regulus is not immediately removed, the containing vessel will be broken, owing to the unequal expansion of the porcelain and the metal.



The best proportions for a quantitative separation are, to 1 part of the expected platinum metals, from 20 to 30 parts of zinc. For an ordinary separation, 7 parts of zinc are sufficient.

For the extraction of the residues remaining after our treatment with nitric acid, this method is admirably adapted. By fusing only once with zinc for two or three hours, all the platinum metals are extracted. The operation is the following:—

From 3 to 3.5 kilos. of commercial zinc were fused in a 2-litre Hessian crucible, chloride of ammonium, from time to time, strewn upon it, the 400 grms. of residue, previously heated to faint glowing with chloride of ammonium were added, and the temperature kept, for two or three hours, just above the fusing point of the alloy, by adding, whenever the mass threatened to solidify, some chloride of ammonium. The mass is divided into three strata after solidification has taken place.

The *outer* stratum, easily broken away by a blow from a hammer, contains *no* platinum metals. The *next* contains some particles of the zinc and platinum alloy, imbedded in the basic chloride of zinc; it is porous, and not very thick.

The *inner* stratum consists of a frequently beautiful crystalline regulus. To obtain the alloy from the middle stratum, it is only necessary to wash repeatedly with water; and the alloy gained is, of course, to be added to the regulus. To obtain this regulus as pure as possible, it was again fused with 500 grms. of zinc and some chloride of ammonium, then granulated in water, and the granules dissolved in fuming hydrochloric acid. The acid attacks the regulus with the greatest energy, and the solution was completed in less than an hour. The chloride of zinc can be used for the next operation.

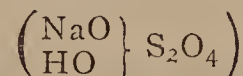
The platinum metals are found at the bottom of the vessel, in the form of a finely-divided black powder, which is impurified with zinc, and with traces of iron, copper, &c., from the latter. It cannot be purified with nitric acid, nor with aqua regia, for part of the platinum metals will thereby be dissolved, or, at best, so suspended in the fluid that filtration is impossible. If, however, the powder is treated with hydrochloric acid, singularly enough, all the impurities are dissolved; not only zinc and iron, *but also lead and copper, dissolve readily, with the generation of hydrogen.* The explanation is readily found in electrical currents produced by the contact of the metals, the stream passing from the positive zinc, iron, &c., to the negative platinum metals, hydrogen being given on the latter, and chlorine on the former, and uniting with them. The metals (rhodium, iridium, &c.), after thorough washing, weighed 65 grms. This powder possesses the property, upon being gently heated, of exploding weakly, and, when highly heated, with violence, the explosion being accompanied with the evolution of light; thereby neither hydrogen, nor chlorine, nor nitrogen, nor aqueous vapour are given off; and, as these are the only elements which it is possible that the metallic powder could have taken up, it must be assumed these metals are, by our treatment, converted into an allotropic condition, and that, upon heating, they return, with more or less energy, to their original condition. The powder contains, mainly, rhodium and iridium; but there are traces present of platinum, palladium, lead, copper, iron, and zinc.

It was intimately mixed with about three or four times its weight of completely anhydrous chloride of barium, and a stream of chlorine gas led over it at a tolerably high temperature. The operation is concluded when particles of sesquichloride of iron show themselves on the neck of the flasks containing the powder. It is carefully brushed away with filter-paper. Some water was now added, and the mass of the platinum metals dissolved with the evolution of heat. There remained behind 13.7 grms. of insoluble matter, which, upon reduction with hydrogen, alloying with zinc, and treatment with hydrochloric acid, furnished 4.5 grms. of ruthenium. From the original 65 grms. of metal-powder, there were

dissolved, in three hours, and with the use of four ordinary burners, 57 grms. of the platinum metals; there being consumed thereby 415 grms. of 85 per cent black oxide of manganese. From this solution all the chloride of barium was removed by careful addition of sulphuric acid [see the precipitation of palladium]. The platinum metals were now completely freed from all other metals, by reduction with hydrogen [with 100 grms. of material, this operation will require five or six days], the temperature being, throughout the operation, maintained at nearly 100° C., by means of the constant water-bath. Platinum and palladium chiefly separate first; then mainly rhodium; and the last portions consist almost entirely of iridium. It is best to break off the operation when the fluid has assumed a greenish-yellow colour. The last portions of iridium (obtained by evaporating the solution to dryness, fusing with carbonate of soda, and treatment with aqua regia) were added to the portion, afterward to be again rendered workable by renewed treatment with chloride of barium. The operation of reduction is hastened by concentrating the fluid; in doing which care must be taken to guard against explosion, on account of the hydrogen. The separated metals were treated with aqua regia, and the platinum and palladium thus dissolved were separated from each other as above described. The traces of rhodium and iridium in the mother liquid can be removed entirely by continued boiling with iodide of potassium (whereby they precipitate as iodides) dissolved in aqua regia and added insoluble portion.

This insoluble and partly-oxidised portion was now again reduced in hydrogen gas, treated, as before described, with chloride of barium, and, after the removal of the barium, the last traces of platinum and palladium removed by boiling with caustic soda. Rhodium and iridium now alone remained to be separated.

The brown-red fluid was, for this purpose, evaporated with hydrochloric acid, and, after filtration, treated with bisulphite of soda—



in *great excess*, and the whole allowed to remain quietly in the cold for several days. The double salt of rhodium ( $\text{NaOSO}_2, \text{RhOSO}_2$ ) separates slowly, giving a lemon-yellow precipitate. The solution becomes lighter and lighter, and finally almost colourless. The colour of the precipitate changes with that of the fluid, becoming, with it, lighter. This precipitate, upon washing, contained the rhodium almost pure.

Upon heating the fluid gently, a yellow-white precipitate separated, which consisted mainly of rhodium, but contained, also, some iridium. After filtering off this precipitate, the solution, upon being concentrated to a small volume, gave yet two precipitates—

1. A curdy, slowly-separating, yellowish-white precipitate, nearly chemically pure iridium, containing but the faintest traces of rhodium.

2. A heavy, crystalline powder, quickly separating, which was readily freed from the first by decantation, and weighed 16 grms. Upon testing, it gave all the reactions for iridium, but likewise some peculiar reactions not shown by the latter. It may possibly contain a new metal.

Exclusive of these 16 grms., the precipitate (the first) weighed 99.5 grms. The mother liquid was free from platinum metals. The complete separation of rhodium from iridium was accomplished by treating the yellow precipitates with concentrated sulphuric acid. They were brought in small portions into the acid, heated in a porcelain capsule until all the sulphurous acid had escaped, and then left upon the sand-bath until all the free sulphuric acid had been driven off; and the sulphate of soda formed. Upon boiling the mass of water, all the iridium dissolves as sulphate, with a chrome-green colour; while the rhodium remains behind as a flesh-red double salt of soda and rhodium oxide. It (the latter) was washed by boiling in aqua regia, and decanted with water. It is insoluble in water, hydrochloric or nitric acids, and in



aqua regia. The rhodium and iridium are now completely separated. The rhodium salt weighed 33.2 grms.

The following are the weights of the various precipitates obtained from 1 kilo. of the original residue:—

	grms.
KCl, PtCl <sub>2</sub> .. .. .	117.5
PdI .. .. .	77.0
KCl, PdCl .. .. .	19.0
NaOSO <sub>3</sub> , RhOSO <sub>3</sub> .. .. .	33.2
Ir <sub>2</sub> O <sub>3</sub> .. .. .	9.1
Ru(+Ir) .. .. .	4.5

The first yellow precipitate obtained in the cold by the bisulphite of soda, gave, by this treatment, the rhodium quite pure. The second and third precipitates, containing much iridium, gave a very fine rhodium, but still slightly impurified with iridium. The products, therefore, obtained by this treatment with sulphuric acid (which betray their impurification with iridium by their somewhat brownish colour) were collected for themselves, the rhodium separated therefrom by glowing, treated again with chloride of barium, and the operation of separation repeated. The green solution, containing only iridium, was gradually heated over an ordinary burner, in a porcelain capsule, and, afterwards, upon the sand-bath, to remove the excess of sulphuric acid; and, finally, the capsule and its contents were highly treated in a Hessian crucible. There is formed thereby sulphate of soda and sesquioxide of iridium. Upon boiling the mass with water, the last remained behind as a black, insoluble powder, which was readily washed by decantation. It weighed 9.1 grms.

In these operations, the new filtering apparatus and the continuous water-bath with which I have furnished my laboratory materially shortened the labour.

## PROCEEDINGS OF SOCIETIES.

### CHEMICAL SOCIETY.

January 20th, 1870.

Dr. A. W. WILLIAMSON, F.R.S., &c., President, in the Chair.

THE following gentlemen were elected Fellows:—I. Bell, A. Bird, G. R. Hislop, E. Lapper, H. Seward.

The first paper read was—"Note on the Absorption of Mixed Vapours by Charcoal," by John Hunter, M.A., Queen's College, Belfast.

The author, some time ago, published, in the *Journal of the Chemical Society* (May, 1868), the results obtained by absorbing the mixture of two vapours by means of cocoa-nut charcoal. He found that the absorption was increased when one of the vapours was at a temperature near to its point of condensation; and he explained the phenomenon by assuming that, when a fragment of charcoal is introduced into a mixture of two vapours, the one which is nearest to its point of condensation is first absorbed, and this, in its condensed state in the pores of the charcoal, aids the absorption of the other vapour. According to this view, a succession of condensations is going on. The theory is strikingly illustrated in experimenting with a mixture of water vapour and ammonia gas (obtained by heating an aqueous solution of ammonia of sp. gr. 0.88), when the mixture is much more largely absorbed than either the gas or the vapour separately. The mean of a set of experiments made at 100° and a mean pressure of 706.2 m.m. was—316.6 vols. of the mixture absorbed by 1 vol. of charcoal.

The PRESIDENT remarked that the results were entirely in accordance with what was expected on theoretical grounds.

The next communication was—"The Composition of Iron-Rust," by Dr. Crace Calvert.

The author had lately occasion to analyse rust obtained from two different places—from the outside of the Conway Bridge, and from Llangollen, North Wales; and he found both specimens to be composed as follows:—

Sesquioxide of iron .. .. .	92.900
Protoxide of iron .. .. .	6.177
Carbonate of iron .. .. .	0.617
Carbonate of lime .. .. .	0.295
Silica .. .. .	0.121
Ammonia .. .. .	traces

100.000

This result induced the author to enquire to which of the constituents of the atmosphere the formation of rust is chiefly due. To this end, clean blades of steel and iron were put into tubes filled respectively with oxygen, oxygen and a little carbonic acid, oxygen and moisture, &c. The blades were introduced into the tubes, which then were filled, over mercury, with oxygen. But this proved an unsatisfactory method, inasmuch as always some globules of mercury remained adhering to the iron, whereby a galvanic action was produced, which, of course, induced a rapid oxidation. To avoid this, the tubes were filled simply by displacement of the atmospheric air. The blades were then left exposed to the action of the different agents for a period of four months. The results were as follows:—

Blades in dry oxygen.—No oxidation.

Blades in moist oxygen.—Out of three experiments, only in one a slight oxidation.

Blades in dry carbonic acid.—No oxidation.

Blades in moist carbonic acid.—Slight incrustation of a white colour. Out of six experiments, two did not give this result.

Blades in dry carbonic acid and oxygen.—No oxidation.

Blades in moist carbonic acid and oxygen.—Most rapid oxidation.

Blades in dry oxygen and ammonia.—No oxidation.

Blades in moist oxygen and ammonia.—No oxidation.

These facts led the author to assume that it is the presence of carbonic acid in the atmosphere, and not oxygen or water vapour, which determines the oxidation of iron.

The author next investigated the behaviour of iron in water into which, successively, oxygen, carbonic acid, a mixture of the two gases, &c., was conducted. The results were analogous to those above mentioned, inasmuch as the most effective oxidation took place when a mixture of oxygen and carbonic acid was introduced into the water. The action commenced immediately, and, in a short time, a dark precipitate covered the bottom of the vessel. The oxidation, in these cases, was not due to the fixation of the oxygen dissolved in the water, but to oxygen liberated from the water by galvanic action; the occurrence of hydrogen collected above the liquid in the bottles proved this sufficiently. A further evidence for the supposition that the oxidation of the iron is effected through the decomposition of the water is found in the fact that, when into distilled water which had previously been deprived of all its absorbed gases by continued boiling a bright blade is introduced, it became, in the course of a few days, here-and-there covered with rust. The spots where the oxidation had taken place proved to be impurities in the iron, which had induced a galvanic action, just as a mere trace of zinc, placed on one end of the blade, would establish a voltaic current.

Finally, Dr. Calvert investigated the state of iron in alkalies; and he discovered that, not only the solutions of the caustic alkalies, but of their carbonates as well, protect iron against any oxidising action.



MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, January 11, 1870.

E. W. BINNEY, F.R.S., F.G.S., Vice-President, in the Chair.

THE CHAIRMAN said that he had observed, at Cheetham Hill, on the evening of Monday, the 3rd inst., at 7.30 p.m., a singular display of the Aurora Borealis. It consisted of an arch of white light,  $4^{\circ}$  to  $5^{\circ}$  in breadth, a little south of the zenith, extending from east to west, and passing through the Pleiades; and a column of deep crimson colour, nearly due north, extending from the horizon to about  $40^{\circ}$  altitude, having slightly the character of streamers. The white arch, also, moved slowly to the south. The intensity of the red colour in the pillar was greater than any he had previously observed.

Dr. JOULE said he had not seen the aurora of the 3rd instant referred to by the Chairman; but, having been engaged on the same day in making observations with his new dip circle, he had noticed some remarkable disturbances in the magnetic dip, which no doubt were connected with the auroral display. He had also noticed similar disturbances of the dipping needle during the gale on Saturday, the 8th instant.

Dr. JOULE exhibited his current meter, and with it, in connection with a galvanometer, made an experiment to determine the horizontal intensity of the earth's magnetism in absolute measure. The result gave 3.83 as the value of this element in the hall of the Society. The current employed was produced by a single cell of a Bunsen's battery.

MICROSCOPICAL AND NATURAL HISTORY SECTION.

January 3th, 1870.

R. D. DARBISHIRE, B.A., F.G.S., in the Chair.

Dr. W. ROBERTS exhibited some specimens of urinary calculi, composed of cystine; also some crystals of the same, obtained by evaporation in the open air of the ammoniacal solution. Six-sided plates of mother-of-pearl lustre were obtained in this way which formed brilliant objects for the microscope.

Dr. ROBERTS remarked on the great rarity of cystine calculi, many large museums not possessing a single specimen. He had, in his own collection, three specimens; and, in the Museum of the Manchester School of Medicine, there were portions of two very fine calculi. A certain historical interest attached to one of the latter, a piece of which was presented, by the late Mr. Ransome, to Baron Liebig, during one of his visits to Manchester. The analysis of this piece led to the rectification of a curious error in the original formula for cystine, published by Prout and Lassaigne. These eminent chemists had deduced the formula  $C_6H_6NO_8$ ; but the Giessen analysis discovered 20 per cent of sulphur, which brought the true formula to  $C_6H_6NS_2O_4$ , the 2 atoms of sulphur having been before erroneously reckoned as 4 atoms of oxygen.

Mr. J. SIDEBOTHAM read "*Notes on the Pupa and Imago of Acherontia atropos.*"

Mr. W. BOYD DAWKINS sent, for exhibition, some very interesting microscopic sections of *Eozoon Canadense*, which are the more valuable as being those which have passed through the hands of Sir W. E. Logan and Dr. Carpenter.

Mr. J. B. DANCER, F.R.A.S., presented the Section with a box containing twelve new polarising objects. These partly consisted of some of the hard fatty acids, which form very effective objects, and partly of crystallisations of some of the hydrocarbon compounds, which compete with the best specimens of polarising objects of the present day.

GLASGOW PHILOSOPHICAL SOCIETY.

(CHEMICAL SECTION).

THE ordinary meeting of the Chemical Section was held on Monday last, Mr. Alexander Whiteland, Vice-President, in the Chair. After the admission of some new members and the transaction of some other business, a paper was read by

Mr. J. WALLACE YOUNG, "*On Artificial Alizarine.*" He characterised madder and its preparations as being among the most useful dye-stuffs used in calico-printing and dyeing. The importance of madder is due to the fact that with different mordants it gives a great variety of colours,—iron mordants giving all shades from black to delicate purple; those of alumina giving colours from a dark red to a fine pink; and a mixture of them giving various shades of chocolate. Madder root has undergone probably more chemical investigation than any other colouring matter—the investigators being Robiquet and Colin, Claubry, Persoz, Runge, Schunck, Higgin, &c. The most important colouring matter is alizarine; from it may be obtained all the durable and brilliant colours yielded by madder itself. Mr. Young described the method by which alizarine may be obtained readily from madder root, and mentioned that the substance appears ultimately as a sublimate of fine orange-red needles, which are slightly soluble in hot water, and readily soluble in boiling alcohol. Owing to the high price of madder and madder preparations, much interest attaches to every substance which purports to be a substitute for madder. A good substitute would be gladly welcomed. M. Roussin announced a few years ago that he had succeeded in obtaining artificial alizarine from naphthalin, but further investigation proved that he had been mistaken. More recently, it had been announced in the CHEMICAL NEWS and elsewhere that artificial alizarine had been successfully obtained from anthracen.

Mr. Young then stated the results of his experiments upon two madder substitutes, one of continental manufacture, a thin dark coloured paste containing 5.7 per cent of dry residue, the other of English manufacture, supplied in the form of an opaque brownish liquid. The former contained a large amount of coloured matter, but further purification was necessary before it could be used as a madder-substitute. When mordanted cloth dyed with it was boiled with solution of soap, the colours were found to be rather fugitive. Cloth prepared for Turkey-red absorbed the dye-stuff readily, but the same want of fastness was observed. When mixed with iron and aluminous mordants, and printed on in the way in which madder extract is used, the colours were found to be dull and not sufficiently fast. A sublimate obtained from the dried paste closely resembled natural alizarine, but was rather lighter in colour. It dyed mordanted cloth well and withstood treatment with soap. The English made madder substitute yielded a red rather yellower than that yielded by natural alizarine, a black of equal, if not superior quality to madder-black, but the chief difference was in the purple, which was rather slate-coloured than anything else, contrasting most unfavourably with the fine shade of colour given by madder. The yellowness of the red seemed to depend pretty much on the proportion of tin salt used in the clearing. As with madder and its preparations, the development of the colouring matter of the artificial alizarine is increased by tanning materials, as sumac, and deteriorated by chalk. The dried residue of the brown artificial alizarine liquid yielded by sublimation a crystalline body of a yellower shade than that of the crystals of the natural alizarine. In order to compare the artificial alizarine with the natural substance and with purpurine, which is another madder extract, the author dissolved each of them in weak ammonia, and added barium chloride; they all yielded purplish precipitates. The natural alizarine precipitate was of a fine



bluish-purple colour, and the supernatant liquor was almost quite clear; that from the artificial product was much redder, and the supernatant liquid was highly coloured; the purpurine precipitate was of a purplish-red colour. The natural alizarine and purpurine precipitates did not seem to be much affected by being washed several times with cold water, but the artificial alizarine precipitate gradually dissolved in the washing water and finally disappeared. Mr. Young thoroughly tested the dyeing powers of the new alizarine by comparing the results produced upon mordanted cloth either with equal weights of sublimed alizarine obtained from the two artificial preparations and from madder, and of purpurine; he showed the specimens of cloth so treated. Instead of the dark full red given by the natural substance, the artificial alizarine yielded only a yellowish-red, much like that of the purpurine. Its purple was of a slatey tint, but the chocolate and black differed very slightly from those of the natural alizarine. The purpurine scarcely gave any purple, and the same is true of the Continental and English madder-substitutes. Alcoholic solution of natural alizarine gives a fine purple colour with copper acetate, and with the same reagent the artificial preparation gives a very red purple. No characteristic bands appear in the spectrum when artificial alizarine is used, and, therefore, purpurine is shown to be totally absent. The author was not aware if anything had been done towards establishing a formula for the new alizarine, but, his opinion arrived at after performing many practical experiments, was that there was some essential difference between the artificial and the natural substance. He had found no superiority in the new substance. In a supplement to the paper of which the foregoing is an abstract, Mr. Young said that the manufacture of artificial alizarine is carried out in two or three ways by continental chemists, and from the examination which has been made of the products, it would appear that some of them consist of a mixture of alizarine and purpurine, in different proportions, and some of alizarine, or of a substance intermediate between the two. It had been said that it was more advantageous to use the artificial alizarine as a dry paste, rather than in the dry state, but he could find no difference in the dyeing power. He had treated the artificial alizarine with boiling dilute sulphuric acid, as in garancine making, afterwards washing thoroughly and drying: he had also dissolved it in sodium carbonate, precipitating with acetic acid, washing, and drying; but the colours given on drying did not seem to be modified in any way.

A discussion followed, in which several gentlemen took part. There seemed to be much doubt as to the mode of preparing the artificial alizarine, and if it could be produced in large quantity, considering the small amount of anthracene, which exists in coal-tar. On that point, however, it was stated by Mr. Hogg that it could be supplied in considerable quantities and at such a price as would make it cheaper than madder.

A paper then followed "*On the Estimation of Iodine and Bromine in the Mother Liquors from Saltpetre and in Kelp*," by Dr. Clark. The author submitted a process by which the tediousness may be avoided which attends most of those which aim at estimating iodine and bromine existing in the combined state in presence of a large excess of chloride. He considered it specially applicable for the estimation of iodine and bromine in the mother liquors from saltpetre. A measured quantity of the liquor is introduced into a long tube with twenty alkalimeter measures of bisulphide of carbon; and nitrous-sulphuric acid (prepared by passing nitrous acid through sulphuric acid) is added, drop by drop, till iodine ceases to be liberated. The tube is inverted several times after the addition of each drop of acid, in order that the iodine may at once be dissolved by the bisulphide of carbon, to which it gives a violet colour, varying in intensity with the amount of iodine in solution. The quantity of the iodine is estimated by comparing the degree of the colour with

that which results when a standard solution of iodide of potassium is used in the same way. The author affirmed the delicacy of the reaction to be such, that 0.01 gr. would communicate a distinct rose tint to the bisulphide of carbon. When the amount of iodine exceeds 0.2 gr. of iodine in the quantity operated on, a difficulty occurs, as the violet colour becomes so deep that the various shades cannot be distinguished with accuracy. When all the iodine is separated by the bisulphide of carbon, the solution containing the bromine is introduced into another tube, and the bromine is liberated by chlorine-water in the usual way, and taken up by a fresh quantity of bisulphide of carbon. In this case, an orange colour is the result, and the amount of bromine may be estimated by comparing the colour with that resulting when a solution of bromide of potassium is used of known strength. A sample of saltpetre mother liquor treated in the way mentioned gave the results—

Iodine .. ..	145.3	grs. per gallon.
Bromine .. ..	2094.5	" "

The same process, slightly modified, may be used to determine the amount of iodine and bromine in kelp.

Mr. STANFORD said that, so far as iodine was concerned, the process mentioned by Dr. Clark was a good commercial process, but he doubted if it would be of use with bromine.

Mr. TATLOCK considered that the process was not specially novel, and that it was liable to the same objections that apply to colour tests generally. He could put little or no confidence in such tests.

## CORRESPONDENCE.

### THE CAVENDISH SOCIETY.

*To the Editor of the Chemical News.*

SIR,—It may be satisfactory to many of the old members of the Cavendish Society to be informed that the Society is not extinct. I was present at the last public meeting, held under the presidency of Mr. Graham, when it was resolved—1. To accept the offer of Messrs. Harrison to relieve the Society from its liabilities, and to complete the translation of "Gmelin's Chemistry," including a full index, on the condition that the Society surrender to Messrs. Harrison the remainders of the works issued by the Society (already printed and published by Messrs. Harrison), and also the right of sale, at a stipulated price, of the volumes required to complete "Gmelin's Chemistry." 2. That the President, Council, and Secretary, hold office until this engagement with Messrs. Harrison be fully carried out.

Mr. Watts has already explained the cause of the delay in the completion of "Gmelin." Subscribers will see that their interests have been cared for by the President and Council. The Council can meet, at any time, with full powers to act. Should such a meeting be necessary, their first duty will be a melancholy one, namely, to elect a new President, and then, having agreed that the engagement with Messrs. Harrison has been fully carried out, to dissolve the Society.

Although a Member of the Council I have no official authority whatever for making the above statement, nor do I know of any means, short of summoning the Council, for procuring such a statement. But as so many inquiries and complaints have been made respecting the present position of this Society, I trust it will not be thought impertinent if I thus supplement Mr. Watts's letter.—I am, &c.,

C. TOMLINSON.

Highgate, N., Jan. 24, 1870.



GMELIN'S CHEMISTRY AND WATTS'S  
DICTIONARY.

To the Editor of the Chemical News.

SIR,—Every chemist and possessor of "Gmelin's Chemistry" will, I am sure, in common with myself, be glad to have seen Mr. H. Watts's letter in the last number of the CHEMICAL NEWS, and to hear that there is at last a chance of this very valuable work being completed.

Whilst on this subject, I would refer to Mr. Watts's "Dictionary of Chemistry," and should like to know if there is any probability of the hint being acted upon, which, I believe, you originated at the time this latter work was completed—viz., the annual publication of a supplement which would contain the contributions to chemical science for the year preceding. Such a book is published in Germany, and is a great boon to all chemists; but, with a work like Watts's "Dictionary" as a starting point, the further labours of its eminent compiler, than whom there is no one more competent, would be much more valuable.

I am sure that all my brother chemists would only be too glad to purchase the book at a price which would well remunerate the publishers.

JOHN G. DALE.

Laboratory, Mersey Bank,  
Warrington, January 22nd, 1870.

OBITUARY.

A. PAYTON HURLSTONE.

WE record, with pain, the death of a valued friend and talented contributor to the CHEMICAL NEWS. Adam Payton Hurlstone, M.R.C.S., M.B., B.Sc., &c., died on the 21st of December, in the 24th year of his age, on board the steamship *Laplace*, on his passage from Brazil, where he had been pursuing his studies in botany, geology, &c.; he was buried the same day, at sea. Since leaving Cheltenham Grammar School, Mr. Hurlstone's scientific and medical studies had been pursued at University College, where he distinguished himself by carrying off, at an early age, the highest prizes for which he competed. It is to be feared that his unremitting devotion to study, acting on a frame not naturally robust, sowed the seeds of premature disease; and, with a view of combating unfavourable symptoms, he was advised to try the effect of foreign travel and sea voyages. We had great hopes that his health would, by this means, have been restored, and that he would soon have been enabled to continue that career of usefulness of which his talents gave such ample promise. At one time, he was a frequent contributor to the CHEMICAL NEWS, and some of the best reviews and unsigned articles which have ever appeared in these pages were from his pen. His relatives wish to take this opportunity of intimating their great loss to his many scientific friends.

MISCELLANEOUS.

The Royal Mint.—Mr. W. Chandler Roberts, F.C.S., As.R.S.M., has been appointed chemist to the Mint. We call attention to this with the greater pleasure because it is a new chemical appointment in connection with the Government. The laboratory will, we believe, be partly devoted to research—the first laboratory of this sort established by the Government. Mr. Roberts was for some years assistant to the late Professor Graham, and associated with him in hydrogenium researches; we, therefore, hope

that Mr. Roberts will continue his experiments on this subject, and that this new recognition of science on the part of the Government may lead to many useful discoveries.

CHEMICAL NOTICES FROM FOREIGN  
SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus des Séances de l'Académie des Sciences, January 3, 1870.

This number, a great portion of which is devoted to the records of the proceedings of the elections of President, Vice-Presidents, and Membres du Bureau, contains the following original papers and memoirs relating to chemistry and allied sciences:—

On the Nascent State.—M. St. Claire-Deville.—This paper is identical with that already briefly alluded to (see CHEMICAL NEWS, vol. xxi., p. 36).

Action of Magnetism upon Gases.—M. Trève.—This paper contains a first short account of a series of experiments made with perfectly pure gases enclosed in so-called Geissler tubes, and submitted to the action of the induction-spark and an electro-magnet of great force.

Origin of Nitrogen Gas Present in what is supposed to be Perfectly Pure Oxygen.—M. Houzeau.—The author mainly states that atmospheric air adheres with so great tenacity to all parts of the apparatus employed for the production of oxygen and hydrogen, that the author found it necessary to heat to redness even narrow tubes, in order to expel the air, while at the same time a rapid current of pure oxygen passed through the same.

Some Remarks on the Artificial Manufacture of Precious Stones.—M. Gaudin.—The author states, in reference to what has been done on this subject by M. Feil, that he (the author of this paper) made artificial precious stones in crucibles many years ago, but that it is far more difficult to obtain really good results by that method than by the use of the oxyhydrogen blowpipe, and that only by the use of the latter really hard stones, not acted upon by the file, can be made.

Motion of Chlorophyl Globules Under the Influence of Light. M. Prilleux.—A botanico-physiological paper.

Manufacture of Platinised Looking-Glasses.—M. Jouglet.—Abstracted from another periodical.

Two Products from the White Agaricus.—M. Fleury.—The dried agaricus (a kind of mushroom) yields, on being treated with ether, after evaporation of that fluid, two substances—viz., a resin,  $C_{51}H_{82}O_{10}$ ; and agaricic acid,  $C_{16}H_{28}O_5$ .

Toxicological Properties of Some Rosolates.—M. Guyot.—The author states that the rosolates of potassa, soda, and baryta do not at all act upon the skin; the soda and potassa salts are not poisonous when they are inwardly taken, or introduced into the animal system; rosolate of baryta is poisonous in strong dose, in consequence of the poisonous properties of the base itself.

January 10th, 1870.

Nitrous Acid.—M. Fremy.—The author considers this acid under the three following headings:—(1) Action of water upon nitrous acid. This decomposition is represented by the following formula:—



This reaction is modified, however, by the relative quantities of acid and water, as well as by the temperature. When the acid is in excess, there is only nitric acid and deutoxide of nitrogen formed. When a large quantity of cold water is brought into contact with nitrous acid, the latter dissolves in the water, and no decomposition whatever takes place; this solution is far more stable than one would at first think—even a boiling heat does not destroy it at once. (2) Reducing action of the acid.—In this respect, the aqueous solution just alluded to has some similarity with sulphurous acid, chloride of gold is reduced instantaneously, and permanganate of potassa is decomposed. Nitrous acid decomposes sulphuretted hydrogen precisely in the same manner as sulphurous acid does. The author discusses, at some length, the action of nitrous and sulphurous acids in their respective relations to the manufacture of sulphuric acid; and, from his observations, he comes to the conclusion that an excess of sulphurous acid gas in the leaden chambers, and too high temperature, are the real causes of the useless waste of nitrous compounds in the manufacture of sulphuric acid on the large scale. (3) Decomposition by means of



hydrogen.—While experimenting on this subject, the author has discovered a new substance in the following manner:—Nitrate of potassa is calcined in a platinum crucible, and nitrite of potassa formed; this is dissolved in water, and the solution thus obtained submitted to the action of sodium amalgam. The nitrite becomes reduced, and the new substance is obtained, exhibiting the following properties:—It decomposes instantaneously, and at the ordinary temperature, the salts of gold, silver, mercury, and copper, yielding, with the three first-named, the pure metals, and, with the last, the hydrated peroxide. Even when an excess of alkali is present, permanganate of potassa solution is instantaneously decolourised; heated with an excess of alkali, ammonia and protoxide of nitrogen are given off, and the reducing properties are at once lost. The researches on this substance are not finished yet.

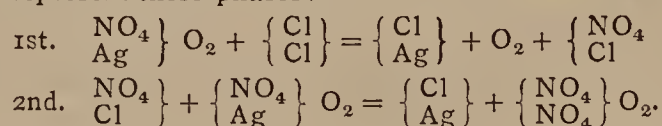
**Eighth Memoir on the Electro-Capillary Phenomena. Part II. On the Cause of Electric Currents of the Muscles, Nerves, and Bones.**—M. Becquerel.

**Estimation of Weak Electro-Motive Force.**—M. Becquerel.

**Constitution of the Solar Aureola, and on the Phenomena Exhibited by Rarefied Gases Rendered Incandescent by means of Electric Currents.**—Rev. Father Secchi, S.J.—A lengthy paper accompanied by several diagrams.

**Manufacture of Tam-Tams and Cymbals.**—MM. Riche and Champion.—This paper gives a description of the mode of manufacture of the metallic drums often imported from China under the name of gongs. The alloy made use of by the authors consists of 78 per cent of copper and 22 per cent of tin. The operations chiefly consist in a well-managed beating out and annealing of the disc, which is cast of a thickness of 23 m.m. originally.

**Action of Dry Chlorine upon Dried Nitrate of Silver.**—MM. Odet and Vignon.—The authors, referring to a former paper published by them on this subject, now state that there are two phases to be distinguished in the reactions which here take place—viz., first, chloride of azotyl is formed, and oxygen set free; and, secondly, the chloride of azotyl reacts upon the excess of nitrate of silver. The following formulæ represent these phases:—



**Synthesis of Hydrosulphuric Acid.**—M. Boillot.—The author states that, having filled gas jars with hydrogen, and having placed some sulphur in the same, the passing of an electric spark through the latter, igniting and volatilising it, produced a perceptible quantity of sulphuretted hydrogen.

**Analysis of the Waters Contained in Arable Soils.**—M. Schlöesing.—This interesting paper is chiefly made up of results placed in a tabulated form, and, hence, not well suited for useful abstraction.

**Reply to M. Guadin's Paper "On the Manufacture of Artificial Precious Stones."**—M. Feil.—A question of priority.

*Berichte der Deutschen Chemischen Gesellschaft zu Berlin*, No. 17, 1869.

This number contains the following original papers:—

**The Antecedents (Vorstufen) of Urea in the Animal Organism.**—MM. Schultzen and Nencki.—This paper, communicated from the chemical laboratory attached to and forming part of the anatomical dissection rooms, contains the record of a series of experiments instituted with dogs in order to elucidate, and, if possible, explain, the mode of the formation of urea and the prodromi of that substance.

**Iodide and Bromide of Mercury.**—M. Oppenheim.—The iodine compounds of the alcohol radicals do not act upon bichloride and bibromide of mercury in the same manner. In the case of the iodides of the alcohol radicals and the bichloride of mercury, there is formed at once an organic chloride and red iodide of mercury; but when organic iodides are brought into contact with bibromide of mercury in alcoholic solution, no action takes place. When, however, bibromide of mercury is dissolved in acetone, and the experiment repeated with this solution, a yellow crystalline substance is obtained; on investigation, this substance proved to be soluble in ether, to sublime without decomposition, and to have for its formula  $\text{HgIBr}$ . The authors observe that the formation takes place according to the formula  $\text{RI} + \text{HgBr}_2 = \text{RBr} + \text{HgBrI}$ , and that its composition is a new proof of the correctness of the atomic weight of mercury = 200.

**Isomorphism of the Compounds of Mercury containing Two Atoms of Chlorine, Bromine, Iodine, and Cyanogen.**—M. Groth. A crystallographical paper illustrated by diagrams.

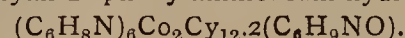
**Critical Remarks upon the Paper Read by M. Thomsen, "On the Estimation of the Heat Given Off by the Combustion of Organic Compounds."**—M. Baeyer.

**Cresylo-Purpuric Acid.**—M. von Sommaruga.—The raw material employed by the author for his experiments is trinitro-cresylate of ammonia, an article of commerce known under the name of Victoria yellow. After having purified this salt by re-crystallisation, it was dissolved in water, and yielded, on the addition of hydrochloric acid, trinitro-cresylic acid. Instead of treating this acid with cyanide of potassium, the author prefers to use the purified Victoria yellow at once, and obtains, on addition to that substance an aqueous solution of the cyanide just named, the cresyl-purpurate of potassa,  $\text{C}_9\text{H}_6\text{N}_3\text{KO}_6$ . When dry, this substance, on being suddenly heated, detonates. A

concentrated solution of this salt yields, on being mixed with a concentrated solution of chloride of ammonium, the ammonia salt of the new acid—viz.,  $\text{C}_9\text{H}_6\text{N}_3(\text{NH}_4)\text{O}_6$ .

**Researches on Sandal-Wood.**—M. Weidel.—After referring to some old researches on this subject, the author states that he exhausted 20 lbs. of the sandal-wood shavings, first, with boiling water, to which some caustic potassa had been added. The deep red-coloured liquid was neutralised with hydrochloric acid, whereby a bulky brick-coloured precipitate was thrown down. This substance was collected on filter, washed, and dried, and next treated with ether, the excess of the latter removed by means of distillation, the residue diluted with alcohol, and left to evaporate by itself. The author thus obtained, among several coloured substances, a colourless crystalline body, which is soluble in boiling alcohol. This substance, not hitherto known, has been called by the author "santal;" it is only readily soluble in dilute solutions of caustic alkalies, but these solutions soon become coloured while in contact with air, passing from red, through green, to a dirty brown. The alcoholic solution of santal is neutral to test paper, and is coloured deep red with perchloride of iron. Concentrated sulphuric acid dissolves santal, exhibiting a lemon-yellow coloured solution; formula of the dry substance,  $\text{C}_8\text{H}_6\text{O}_3$ . The author also found a cinnabar-red coloured crystalline material, which he called "santaline," though it is not quite identical with the santalin of M. Meier; according to M. Weidel's analysis, this santalin is  $\text{C}_{14}\text{H}_{12}\text{O}_4$ . It is probable that santal is in some manner connected with santalin, but this point is a subject for ulterior investigation.

**Double Cyanogen Compounds.**—M. Weselsky.—This lengthy memoir is divided into the following sections:—Double cyanides, having the general formula  $\text{BaCy}_2 \cdot \text{R}_2\text{Cy}_2$ ; sodiumcobaltocyanide,  $\text{Na}_6\text{CO}_2\text{Cy}_{12} \cdot 4\text{H}_2\text{O}$ ; ammoniumcobaltocyanide,  $\text{Am}_6\text{CO}_2\text{Cy}_{12}$ ; phenylammoniumcobaltocyanide,  $(\text{C}_6\text{H}_5\text{N})_6 \cdot \text{CoCy}_{12}$ . And a series of more and more complicated bodies, as instance of which we quote—phenylammoniumcobaltocyanide phenylammonium hydrate—



**Preparation and Properties of Hydrate of Chloral.**—M. Thomsen.

**Preparation of Selenic and Selenious Acid.**—M. Thomsen.—Selenium is acted upon with concentrated nitric acid, and the solution obtained is evaporated until selenious acid begins to sublime; the residue is dissolved in water. This solution may contain, beside selenious acid, some sulphuric and selenic acid; in order to separate these from each other, baryta water is added. Since selenite of baryta is readily soluble in an excess of selenious acid, the addition of baryta water is continued until a small quantity of the fluid having been filtered does not yield any longer a permanent precipitate on the addition of some more baryta water. The fluid, having been filtered, is evaporated to dryness and submitted to sublimation; the selenious acid thus obtained is quite free from selenic and sulphuric acids. Selenic acid is prepared from this selenious acid by dissolving the latter in water, precipitating this solution with nitrate of silver; the insoluble selenite of silver thus obtained is shaken up with a mixture of water and bromine until the latter is in slight excess. The solution, having been filtered and concentrated by evaporation, yields selenic acid, quite free from sulphuric or selenious acid.

**Simple Method for Recovering Iodine from Iodide of Mercury.**—M. Henry.—The iodide of mercury is digested with water to which granulated zinc or iron borings are added. A soluble iodide of zinc or iron is obtained; from which the iodine is separated by means of sulphurous acid.

**Parachlorotoluidine.**—MM. Henry and Radziszewski.—The substance is a solid, hard, brittle, white-coloured body, fusing at  $85^\circ$ , and boiling, without decomposition, at  $243^\circ$ .

**Contribution to the History of Sulphuretted Ureas.**—Dr. A. W. Hofmann.—A lengthy and concisely-written memoir, not well suited for abstraction.

**Some Ethers of Cresol.**—M. Fuchs.—The author describes—Ethylcresol,  $\text{C}_9\text{H}_{12}\text{O}$ ; ethylparaoxybenzoic acid,  $\text{C}_9\text{H}_{10}\text{O}_3$ ; ethylenecresol,  $\text{C}_{16}\text{H}_{18}\text{O}_2$ ; acetylcresol,  $\text{C}_9\text{H}_{10}\text{O}_2$ .

**Paratoluidine and Bromotoluol.**—M. Wallach.—A critical review of M. Rosenstiehl's labours on this subject.

*Revue Hebdomadaire de Chimie*, January 13, 1870.

**Action of Sulphuretted Hydrogen upon Hydrated Peroxide and Peroxide of Iron at the Ordinary Temperature of the Air.**—M. Brescius.—The author has investigated this reaction by means of the following experiment:—Chemically-pure hydrated peroxide of iron was placed in a glass tube, and all the air expelled by means of a current of carbonic acid gas, which was made to pass, previously to reaching the tube, through freshly-precipitated carbonate of iron suspended in water, in order to remove from the carbonic acid every trace of atmospheric oxygen. A current of sulphuretted hydrogen (also free from air) was then passed over and through the hydrated peroxide for twenty-four hours, and the excess of the latter gas removed by a current of dry and pure carbonic acid, care being taken to bring the temperature to  $50^\circ$ , in order simultaneously to dry the sulphuret obtained. The product thus obtained oxidises only very slowly in contact with dry air, and contains hardly more than mere traces of free sulphur. The author, therefore, concludes that the reaction takes place according to Berzelius's view, represented as follows:— $\text{Fe}_2\text{O}_3 + 3\text{HS} = \text{Fe}_2\text{S}_3 + 3\text{HO}$ . When perfectly pure and dry peroxide of iron is experimented with under the same conditions, no reaction whatever ensues.

**Action of the Oxygen of the Air upon Sulphuret of Iron.**—M. Wagner.—According to the author, sulphuret of iron does not,



when exposed to air, change into sulphate or sub-sulphate, but is converted into sulphur and peroxide of iron. Only traces of sulphuric acid are formed at the ordinary temperature; and only when more heat is applied is this acid more abundantly formed. In order to prove this by experiment, monosulphuret of iron was carefully prepared, and divided into three portions. One of these was kept constantly moist, and at nearly 100°, during three weeks. The second was also kept moist, and left at the ordinary temperature of the air. The third, after having been previously dried, was, for three weeks, left in contact with dry air at the ordinary temperature [the sulphuret was dried by means of a current of illuminating gas, at 100°, since a current of air, dried by means of strong sulphuric acid, oxidises the material]. The results of the analysis of these samples, recorded per centically, gave, for—(I.) Sulphur, 24.35; sulphuric acid, 7.76; ferrous oxide, 61.72; ferric oxide, 6.17. (II.) Sulphur, 28.32; sulphuric acid, 0.96; ferrous oxide, 61.51; ferric oxide, 9.21. (III.) Sulphur, 27.94; sulphuric acid, 2.39; ferrous oxide, 46.43; ferric oxide, 23.24.

**Platinised Looking-Glasses.**—M. Joulet.—The platinising compound is prepared in the following manner:—100 grms. of very thin platinum foil is dissolved in aqua regia, the solution carefully evaporated to dryness, the solid chloride next placed on a triturating marble, and gradually mixed with essential oil of lavender. When 400 grms. of the latter have been incorporated with the chloride, the mixture is placed into a porcelain capsule and left standing for several days, the fluid is decanted from any sediment, and filtered as flux. For the above-named quantity of platinum, the following ingredients are used:—25 grms. of litharge and 25 grms. of borate of lead, mixed and triturated together with about 10 grms. of essence of lavender; this mixture is next mixed with the platinising fluid. After a layer of platinum has been formed upon the glass, it is fixed by burning it in by placing the glass in peculiarly-constructed muffles.

**Depositing Copper upon Cast-Iron.**—M. Weis-Kopp.—The pieces of cast-iron are first placed in a bath made of 50 parts of hydrochloric acid, at 15° Beaumé (sp. gr., 1.105), and 1 part of nitric acid; next, in a second bath, composed of 10 parts of nitric acid, 10 parts of chloride of copper, dissolved in 80 parts of the same hydrochloric acid as just alluded to. The objects are rubbed with a woollen rag and a soft brush, next washed with water, and again immersed until the desired thickness of copper is deposited. When it is desired to give the appearance of bronze, the coppered surface is rubbed with a mixture of 4 parts of sal ammoniac and 1 each of oxalic and acetic acids dissolved in 30 parts of water.

Cosmos, January 15, 1870.

**Universal Galvanic Battery.**—M. Delaurier.—The author describes, at great length, and accompanied by a woodcut, a Bunsen cell modified by him. He uses an impure chromic acid, and a mixture of persulphate of iron and sulphuric acid. How the impure chromic acid is prepared is not mentioned. Instead of sulphuric acid, a solution of common salt (1 part in 10 of water) is often applied, and the amalgamation of the zinc is dispensed with; this arrangement appears, according to the statements made, to be satisfactory in many instances. The intensity of the action of the cell when chromic acid, persulphate of iron, and sulphuric acid are used, is very great, and the vapours of hyponitric acid, so deleterious with the Bunsen cells, are, of course, avoided.

**Gases in Arable Soil.**—M. Hervé-Mangon.—Akin to most porous substances, arable soil has the property of condensing gases. The author finds that the quantity of gases thus condensed varies in bulk (for the same quantity of soil) from 2 to 10 volumes of gas.

**Railway from Arequipa to Puno and Cusco (Peru).**—The highest point above sea level of this railroad is 4633 metres (15,096 English feet)\*—that is to say, more than twice the height above the level of the sea that any existing railroad has reached. At the altitude just named, the air is only half as dense at the surface of the ocean; in other words, when the average height of the barometer at the last-named surface is taken at 28 inches at the height alluded to, its average reading will be only 14 inches.

Archives Néerlandaises des Sciences Exactes et Naturelles, vol. xiv., 1869.

This periodical is published at irregular intervals of time, in volumes containing from six to twelve sheets 8vo. The editor, Dr. E. H. von Baumhauer, the Secretary of the Holland Society of Sciences at Haarlem, is assisted by a number of eminent scientific men. This volume contains the following original papers and memoirs:—

**Observations on the Periodical Errors of Micrometer Screws made During the Latest Re-Arrangement of the Astronomical Observatory of Leyden University.**—M. F. Kaiser.

**Improved Method of Direct Estimation of Iron in the State of Peroxide by means of Hyposulphite of Soda.**—M. A. C. Oudemans, jun.—Reserved for full translation, since it bears upon an important subject.

**Synthesis of Terephthalic Acid.**—M. A. C. Oudemans.—After referring to the labours of M. Carius on the subject of the products of the oxidation of benzol, the author states that he found that, beside formic and phthalic acids, there is also formed terephthalic acid, C<sub>8</sub>H<sub>6</sub>O<sub>4</sub>. The quantity obtained of that substance is, however, very small. The preparation, and some of the reactions of this acid, are described at great length.

**Specific Gravity of some Saline Solutions.**—M. A. C. Oudemans.—This paper contains a series of tabulated results of the specific gravity of aqueous solutions of the following salts:—Crystallised sulphate of magnesia, at 14°, and in quantities of from 1 to 40 per cent of the quantity of water; crystallised nitrate of magnesia, at 14°, and in quantities of from 1 to 49 per cent of the quantity of water; crystallised chloride of magnesium, MgCl<sub>2</sub> + 6aq, at 14°, and in quantities of from 1 to 48 per cent of the quantity of water; crystallised nitrate of manganese, at 8°, and in quantities of from 1 to 71 per cent of the quantity of water; crystallised acetate of lead, at 14°, and in quantities of from 1 to 33 per cent of the quantity of water; crystallised nitrate of zinc, at 14°, and in quantities of from 1 to 50 per cent of the quantity of water.

**Application of Avogadro's Theorem to Chemistry.**—Dr. J. W. Gunning.

**Albuminous Substances of the Blood.**—Dr. Heynsius.—A lengthy and very valuable chemico-physiological memoir.

**General Registering Apparatus.**—Dr. Heynsius.—To this paper is added an engraving, essential for the proper understanding of the subject.

**Means of Preserving Wood from being Attacked by the Teredo Navalis.**—Dr. E. H. von Baumhauer.—This paper, too lengthy for useful abstraction, contains the results of experiments made with various kinds of wood, among these several samples brought on purpose, from the Netherlands' West Indies; as well as the results of impregnating European wood with various preservative and other substances. The main result is that, among the latter, creosoting is the only active agent, provided the creosote applied contains a large quantity of carbolic acid and the impregnation be complete.

**Absolute Expansion of Mercury according to M. Regnault's Experiments.**—M. Bosscha.

**Method of Analysis of Milk.**—Dr. E. H. von Baumhauer.—A valuable and extensive memoir on this subject, but, owing to the engravings and large number of tabulated forms added, not suited for useful abstraction.

**Nature of the Fluids Enclosed in some Minerals.**—MM. Vogelsang and Geissler.

**Mineral Oils of the Netherlands' East Indian Possessions.**—Dr. E. H. von Baumhauer.—A very valuable memoir not only for the knowledge it contains on the subject, but owing to its containing compilations from an immense number of analyses and researches on mineral oils dispersed through a large number of periodicals.

**Extent of Surface Occupied by the Deposits of the Various Geological Formations in the Netherlands.**—M. Hartogh Heys van Zouteveen.—From this paper, we learn that the following geological formations are found in the kingdom above named:—Jurassic terrain; cretaceous terrain; tertiary formation; quartair formation, sub-divided into diluvium and modern, or recent formations. The extent of each, and of every distinct species thereof, is accurately exhibited; the curious result arrived at is that 99.9 per cent of the soil of the Netherlands belongs to the quartair formation, while all the rest occupies only about 0.1 of the entire surface (3,283,927 hectares, fully more than 13,000 English square miles. No other country on the face of the globe presents a similar physical constitution.

**Periodical Evolution of Gas in the Protoplasma of the Living Arcellæ.**—M. Hartogh Heys van Zouteveen.

**Electrical Irritation of Amibæ and Arcellæ.**—M. Hartogh Heys van Zouteveen.

**Estimation of the Velocity by which a Luminous Ray is Carried Forward through a Moving Medium.**—M. Hoek.

**Refraction and Dispersion of Flint Glass, Crown Glass, Quartz, and Iceland Spar.**—MM. van der Willigen.

## NOTES AND QUERIES.

**Detection of Fatty Oils from Seeds of Cruciferæ.**—With reference to the method for detecting these oils by boiling with caustic potassa in a silver capsule, M. Grehaut is probably not aware that his process is no novelty. It was known in England prior to the year 1861, and is described in a work bearing that date.—J. W. SLATER.

**Test for Soaps.**—In the CHEMICAL NEWS (vol. xx., p. 44), Professor Schulze proposes to estimate the goodness of soaps by observing the relative quantities required to unharden a standard sample of water—an inversion, in fact, of Clarke's water-test. The proposed method takes for granted (tacitly, at least) that the most caustic soap (i.e., the one containing the largest amount of alkali) is necessarily the best—a totally false assumption. A soap may be bad from presence of sophistications, from imperfect saponification, or from either excess or deficiency of alkali; and it is called good only when, in addition to being genuine and thoroughly "cooked," it contains alkali and fat duly balanced, such balance varying according to the purpose in view. Professor Schulze's test might place an adulterated but caustic soap upon the same level with one genuine but mild, or might even lead us to prefer the former.—J. W. SLATER.

**Fermentation of Sugar.**—(Answer to John Bowring.)—Alcoholic fermentation, upon which you have fixed your ideas, is not the only fermentation of the sugar-refinery, lactic and acetic fermentations being quite as prevalent. My experience does not enable me to say

\* The height of Mont Blanc is, according to Tralles, 14,793.



whether hydric sulphide actually *produces* fermentation of either kind in sugar solutions, but it most unquestionably *favours* fermentation. You surely do not require instructions for the preparation of hydric sulphide. You seem to forget that the sulphide referred to is generated *in* the solution, not introduced after having been generated in a separate apparatus.—W. A.

**Estimating Manganese by Bunsen's Method.**—The following note has been sent us by Mr. Edward Sherer, as an addition to his paper "On the Estimation of Peroxide of Manganese in Manganese Ores" (CHEMICAL NEWS, vol. xx., p. 304). He there stated that in estimating the manganese by the method of Bunsen, the iodine solution gave higher results after standing twenty-four hours than before. He now adds:—These higher results are caused by the liberation of iodine by spontaneous decomposition of hydriodic acid, set free by hydrochloric acid, distilled over during the process, as the following experiment shows:—A few drops of hydrochloric acid were added to a solution of iodide of potassium. The solution remained for some hours colourless, but, after standing twenty-four hours, had become quite yellow, and was found to contain free iodine sufficient to indicate 8 per cent of peroxide of manganese when titrated with hyposulphite.

## MEETINGS FOR THE WEEK.

- MONDAY, Jan. 31st.—Medical, 8.  
London Institution, 4.  
TUESDAY, Feb. 1st.—Royal Institution, 3. Prof. Humphry, "On the Architecture of the Human Body."  
Institution of Civil Engineers, 8  
WEDNESDAY, 2nd.—Society of Arts, 8.  
Pharmaceutical, 8  
THURSDAY, 3rd.—Royal Institution, 3. Prof. Odling, "On Chemistry."  
London Institution, 7.30.  
Royal, 8.30  
Chemical, 8  
Royal Society Club, 6.  
FRIDAY, 4th.—Royal Institution, 8. Mr. Ruskin, "On Verona and its Rivers."  
Geologists' Association, 8.  
Saturday, 5th.—Royal Institution, 3. Mr. Scott, "On Meteorology."

## TO CORRESPONDENTS.

\* \* Vol. XX. of THE CHEMICAL NEWS, containing a copious index, is now ready, price 11s. 4d., by post, 11s. 6d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our office, or, if accompanied by a cloth case, for 1s. Subscribers wishing to complete their sets of volumes are requested to apply to the publisher, who will give them information respecting scarce numbers and volumes. Vol. xxi. commenced on January 7th, and will be complete in twenty-six numbers.

ERRATUM.—The Lat. N. of Nantes was stated in our last number to be about 46° instead of 47° 13' N.

W. L.—You had better advertise for the information you require.

J. W. Slater.—Received with thanks.

Pb.—We are not aware of any method which will practically separate lead and zinc on the large scale other than those contained in Crookes and Röhrig's "Metallurgy," which you quote. A method of separating small quantities of lead from much zinc, without having recourse to the costly subsidence method used at Vielle Montagne, would be of the highest importance.

### BOOKS RECEIVED.

- The Year-Book of Photography and Photo News Almanac for 1870. Edited by G. Wharton Simpson, M.A., F.S.A. London: Piper and Carter.  
Our Domestic Fire-Places. A New Edition. By Fredrick Edwards, jun. London: Longmans, Green, and Co.  
The Body and its Health, for Primary Schools. By E. D. Mopother, M.D. Second Edition. Dublin: John Falconer.  
Second Annual Report of the Committee of the Manchester National Society for Women's Suffrage.  
Notes for Students in Chemistry, Being a Syllabus of Chemistry and Practical Chemistry. By Albert J. Bernays, Ph.D., F.C.S. Fifth Edition. London: John Churchill and Sons.  
A Manual of Qualitative Analysis. By Robert Galloway, F.C.S. Fifth Edition. London: John Churchill and Sons.

Now ready, in crown 8vo., price 6s. cloth.

**On Food; its Varieties, Chemical Composition, Nutritive Value, Comparative Digestibility, Physiological Functions and Uses, Preparation, Culinary Treatment, Preservation, Adulteration, &c.** By H. LETHEBY, M.B., M.A., Professor of Chemistry in the College of the London Hospital, and Medical Officer of Health and Food Analyst for the City of London.

London: Longmans, Green, and Co., Paternoster Row.

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### TO PHARMACEUTICAL AND OTHER STUDENTS.

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# THE CHEMICAL NEWS.

VOL. XXI. No. 532.

## NOTES FROM THE LABORATORY OF A SUGAR REFINERY.

By WILLIAM ARNOT, F.C.S.

(Continued from p. 37.)

### VIII. CHAR "DISEASES."

THE "diseases" to which animal charcoal is subject are very varied in their nature, and proceed from widely different causes. Upon this subject some very erroneous ideas are entertained by many of our refiners, as well as by scientific men. The manner in which certain specifics have been recommended and employed, with a view to cure almost every variety of "disease," testifies to the truth of the assertion. It is the writer's intention in this note briefly to notice the several diseases which have come under his own observation, and with the cause and cure of which he has had more or less to do.

1. *Deficiency of Carbon.*—This is a very serious defect, and one much more prevalent than might be supposed, considering that, in certain classes of refineries, the carbon increases, rather than diminishes, by continued use. A good working char should contain from 9 to 11 per cent of carbon; when it falls below 9, some agency is at work which ought at once to be enquired into. Faulty slides or joints will be admitting air to the ignited char in the kilns or coolers: or the system may be such that the char has to pass through the air on its way from the kilns to the coolers: in either case, a portion of the carbon is oxidised, and the proportion consequently reduced. Or the re-burning may be conducted at too high a temperature, a reaction taking place, in consequence, between the carbon and water—the latter being decomposed, and compounds of the former formed; or, further, deficiency of carbon may arise from the use of sugars containing large proportions of sulphates and sulphites, as indicated in Note III. The cause discovered, the cure is simple—have the kilns repaired, or renewed; re-burn at a more moderate temperature; avoid the use of sugars impregnated with sulphates and sulphites. Of course, attention to these points cannot restore the carbon already gone, but will prevent a further reduction of this valuable agent; the carbon may, indeed, increase, but it is questionable whether the increase will improve the quality of the char. The want of carbon is one of the worst diseases incident to animal charcoal—the reduction of that agent from 9 or 10 per cent to 6 or 7 means a reduction in decolourative power very much greater than these figures indicate; the preservation of the carbon ought, therefore, to be a special study of the refiner. The writer has before him at the present moment a sample of char from a working stock of several hundred tons, containing under 5 per cent of carbon; how a refinery with such a char stock can yield a profit to the refiner is more than he can guess.

2. *Excess of Carbon.*—As already indicated, the carbon usually increases by continued use; in some refineries, this increase is rapid and great, so great, indeed, as to amount to a "disease." This disease may arise from defective washing, or from the use of water containing considerable quantities of vegetable matter. The deposit of carbon, by the decomposition of organic matter in the process of re-burning, clogs up the pores of the char, just as any other impurity does; its injurious action ends there, however, having no active deleterious action in itself, as some other impurities have.

3. *Oxide of Iron.*—The presence of this agent in any considerable quantity may well be considered a "disease": it is most injurious and potent in its action. The faintest trace of iron in the refined product at once manifests itself on the addition of tannic acid or tea; and so injurious to the commercial value of the sugar is the presence of even the minutest quantity of that agent, that its avoidance is worth any expenditure of care and cash on the part of the refiner. Iron may accumulate in char from various causes.—in the process of re-burning there is, no doubt, a slight and unavoidable increase, but, with care, this need not be serious; if, however, defective kilns and careless manipulators are employed, this may prove a very fruitful source of iron. Here, therefore, is another inducement to the refiner to attend to the careful maintenance of his re-burning apparatus. But a more general source of iron is to be found in the action of sour or acid "washings," "scum-waters," &c., upon unpainted or defectively painted cisterns, moulds, &c. These "washings" impregnated with iron are used in dissolving raw sugars, or are concentrated and run through fresh char; a portion of the iron is extracted by the char and is ready to be given up to the first acid liquor that follows. There is thus a constant addition and abstraction of iron, which become about equal when about 0.7 per cent of oxide has been incorporated with the char. A thorough system of painting, with the avoidance of acid liquors, waters, &c., as far as practicable, is recommended. A portion of the iron may be removed from char suffering from this disease by the use of dilute hydric chloride and some other agents; but, as this subject will be treated of in a separate note, it need not be the subject of further remark here.

4. *Lime.*—Accumulations of this agent in the pores of the char reduces the potency of the char as a decolouriser, and may otherwise injuriously affect the sugar liquors passing through it. This is not a disease very common in this country—at least, not to any serious extent. Several refiners, fancying their char was loaded with this agent, have expended large sums upon curative processes, but generally to no purpose, as the lime was more usually found to be deficient than excessive. Beanes's most admirable process for the removal of lime from char has, to a certain extent, failed in this country—not from any defect in the process, but from a want of the material to operate upon. A more ingenious and trustworthy process for the removal of excess of lime could not well be devised; and, on the Continent, where lime rapidly accumulates in the char in the process of refining "beet," the patent process would yield most excellent results. The writer has, on more than one occasion, had cause to feel surprise at statements made about Mr. Beanes's system, especially by chemists. It was defective because you could not wash the char free from acid; could not regulate the supply of gas to the requirements of the char; and other statements have been made, which simply show that the process was never understood by the parties making them. The process is free from all such objections, and, where lime exists in such excessive proportion as to render its removal desirable, no fear need be entertained with regard to the application.

5. *Overburned Char.*—Char that has been repeatedly overburned contracts—shrivels up, so to speak; the pores become smaller, or cease to exist. This is a serious defect, and one which cannot be remedied.

6. *Glazed Char.*—The glazing of char has been attributed to several causes by different writers; but the author although he has given some attention to the subject is by no means satisfied as to the real cause or causes. Friction may have something to do with it; but this is not the initial cause: defective washing will be more likely to account for it. That glazing is injurious to the char is beyond question: when chars become very highly glazed, their decolourative power is more or less reduced.



7. It is only necessary to indicate that two or more of the above diseases may obtain at the same time, and that complication of diseases renders successful treatment very difficult of attainment.

(To be continued).

### ON THE TECHNICAL ANALYSIS OF SOAP.\*

By M. GASTON TISSANDIER.

THE name of soap is given to true salts formed by combining fatty acids (oleic, margaric) with alkalies, such as soda or potash. The quality of a soap is ascertained by determining the proportion of fatty acid and alkali which it contains, and also the foreign substances—such as chlorides, alkaline sulphates, moisture, &c.—which always occur in varying proportions.

**Fatty Acids.**—Dissolve 5 grms. of the soap in question in  $\frac{1}{2}$  a litre of distilled water heated in a porcelain capsule; when dissolved, add a slight excess of dilute sulphuric acid, and let it boil for some minutes, so that the fatty acids may become separated and float upon the liquid. To weigh the fatty acids, cool them, and they will form a cake of grease, which must then be fused, in order to dry them, in a small tared porcelain capsule; this capsule, when again weighed, will give the amount of fatty acids corresponding to 5 grms. of soap.

Wax may also be used to facilitate the weighing. After the first part of the operation has been performed, and the fatty acids are floating, add 7 grms. of white wax, which will melt and mingle with them; cool the whole, take out the cake of wax, and weigh it, previously drying it between double filtering papers. The excess of weight gives the proportion of fatty acids.

**Ash, — Soda.**—Calcine, at red heat, 5 grms. of soap in a platinum capsule. Weigh the ash thus obtained, and dissolve it in 200 c.c. of distilled water; determine the proportion of soda in 100 c.c. by means of normal sulphuric acid (alkalimetric standard), evaporate to dryness, and notice the action of bichloride of platinum upon the residue dissolved in water, to ascertain whether it consists of potash or soda. The estimation of the soda may be verified by directly taking the alkalimetric standard of the soap (5 grs.).

**Chloride of Sodium.**—Estimate the chlorine in 50 c.c. of the solution with the standard silver solution.

**Sulphate of Soda.**—The sulphuric acid is estimated in the remaining 50 c.c. of the solution with chloride of barium.

**Non-Saponified Fatty Bodies.**—These also occur in soap, and may be detected as follows:—Dry 5 grms. of soap at  $110^{\circ}$ , after which treat it with common ether. Agitate it with that liquid in a flask, filter it, wash with ether, and evaporate the solution at  $100^{\circ}$ ; the residue will be the non-saponified fatty bodies. The ether may, perhaps, dissolve a little of the soap; it must, therefore, be ascertained that the residue is really fat—melt it, and try whether it will soil glazed paper.

**Non-Saponified Carbonate of Soda.**—Cut 5 grms. of soap into small fragments, and treat them with boiling alcohol, which does not dissolve carbonate of soda. Filter, and treat the insoluble residue with alcoholic acetic acid, which dissolves the carbonate of soda without acting on the sulphate of soda and chloride of sodium. The acetic solution, evaporated to dryness and calcined, leaves, as a residue, carbonate of soda. Weigh it, and, if verification be required, take its alkalimetric standard.

**Glycerine.**—Dissolve 5 grms. of soap in boiling water, decompose it with dilute sulphuric acid, and separate the isolated fatty acids by decantation. The liquid, which is completely neutralised by the carbonate of soda, is now evaporated to dryness over a water-bath at  $100^{\circ}$  C.; the residue, composed of sulphate of soda and glycerine, is taken up by alcohol, which dissolves only the latter; it is

then filtered and evaporated to dryness, when the residue will be glycerine. This is again taken up by alcohol, re-evaporated, and the residue again weighed, after ascertaining that it possesses all the properties of glycerine.

**Water.**—Cut the soap into thin slices; weigh 5 grms., and dry them on a stove at  $120^{\circ}$  C.

### Composition of Various Kinds of Soap.

Substances estimated.	I.	II.	III.	IV.
Water.. .. .	46.12	24.76	17.55	14.09
Soda .. .. .	4.98	7.30	8.48	9.01
Fatty acids .. ..	37.99	64.50	71.45	74.68
Chloride of sodium..	6.30	3.12	2.12	2.00
Sulphate of soda ..	0.72	0.32	0.40	0.22
Fatty bodies .. ..	1.00	—	—	—
Glycerine .. .. .	2.89	—	—	—
Total .. .. .	100.00	100.00	100.00	100.00

### ON MICROSCOPICAL MANIPULATION.\*

By W. T. SUFFOLK, F.R.M.S.

(Continued from p. 39).

THE subject of drawing materials is of some little importance, and, as it is not treated upon in any microscopical work, a few remarks may not be out of place.

Probably no material is capable of representing elaborate microscopical subjects with so much truth as *water-colour*. When used with all the appliances of the modern school of painting, both colour and texture can be very closely imitated by skilful artists; but few have turned their attention to this subject; and, as the process is costly and not easy to acquire without a considerable amount of study, the use of this mode of representation will, in all probability, be very limited. Those who possess the requisite skill are strongly recommended to make use of it. Even as pictures, groups of aquatic animals and plants are quite as beautiful, both in form and colour, as flower compositions; and no other means of delineation, excepting the still more difficult art of oil-painting, can approach the truth of a highly-finished water-colour drawing. Unfortunately, at present, no means exist of re-producing these beautiful pictures, as their extreme delicacy places them beyond the powers of chromo-lithography.

The effect of outline sketches is much improved by the judicious employment of tints of water-colour; and this is by no means a difficult process, as it is a mere matter of laying on colour; while, in painting proper, quite as much is done by taking off paint as by putting it on, and also every advantage taken of the texture of both paper and pigment.

*Pencil drawing* is particularly useful for microscopical purposes. Fine lines can readily be made, and the shading is capable of much refinement, so that very delicate tissues can be faithfully delineated. Unless the drawing consists entirely of fine lines without shaded tints, the use of hot-pressed or perfectly smooth paper is not to be recommended, but one having a small, fine grain is to be preferred. The paper should always be supported behind on some hard substance, otherwise the pencil-point will cut in, the line be difficult to rub out, and also much of the power of guiding the pencil lost. For delicate

\* *Moniteur Scientifique*.

\* The substance of a course of lectures delivered to the members of the Quekett Microscopical Club, January—April, 1869.



drawings, a piece of thick plate-glass makes an admirable drawing-board. The blocks or solid sketch-books so much used in out-door sketching, when made of a suitable paper, are particularly pleasant and convenient to draw upon. For shading, the pencil should not be cut to a sharp point, but rather kept square. Those with extra thick leads (such as BBBB and EHB) may sometimes be used to advantage, and even the broad, flat crayons known as Harding's tablets. For general outlining with camera or ruled disc, HB, from its freedom, will be found useful. For a fine outline, H should be used. Delicate tints may be obtained by rubbing on black-lead powder with a leather stump; the most convenient is that known as "Harding's." The author has found no black-lead pencils equal to those made by Mr. B. S. Cohen; they are very even in texture, rub out easily, do not readily break, and correspond exactly with the respective marks. The 6 H, made for drawing on wood for engraving, is well adapted for the purpose for which it is intended.

Pencil drawings, and also those in chalk and charcoal, may be permanently fixed by applying freely at the back until the paper is saturated a varnish composed of white (bleached) shellac, made by mixing equal parts of white lac-varnish and methylated spirit. The white lac-varnish is always supplied by Messrs. Winsor and Newton of uniform strength, and will save the trouble and difficulty of dissolving bleached lac. The drawing is to be carefully dried before a fire, and, when completed, may be rubbed with india-rubber with perfect impunity. Water-colour may be freely used in combination with pencil, as it is not affected by this varnish, which does not stain the paper when dry, although it soaks in when first applied, and renders it transparent like oil.

The multiplication of microscopical drawings is a subject worthy of the attention of every observer. With the exception of Dr. Beale,\* no writer on the microscope has given any account of the various processes of engraving; and yet, unless the microscopist can command the services of the very few engravers and lithographic artists who have devoted themselves to the re-production of microscopical subjects, there is, as the author has found by experience, great risk of misinterpretation.

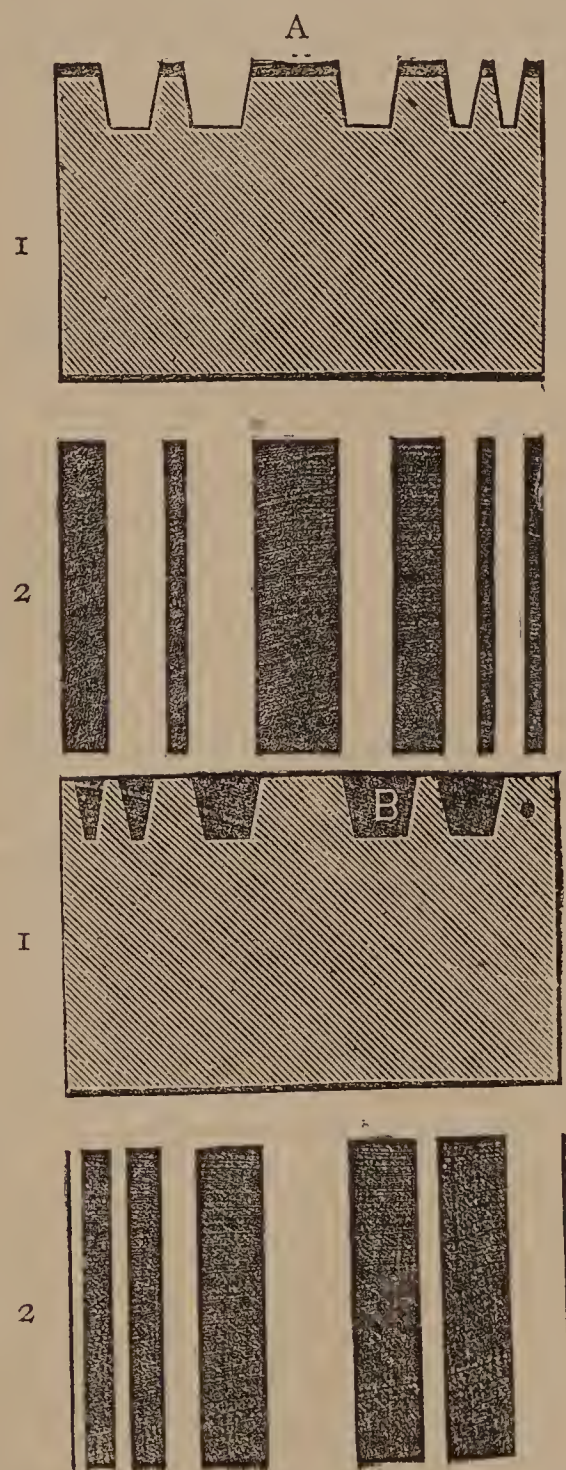
Photography is capable of copying drawings with great exactness, and has no fault saving its cost. When only a small number are required, it would probably, however, be cheaper than any of the printing processes.

The printing processes proper consist of plate and surface printing and lithography.

*Copper and steel plate engraving* consist of cutting lines in a metal plate with a pointed steel tool of square or rhomboidal section, known as a graver. The plate, when finished, is rubbed over with a thick printing-ink, which is afterwards cleaned off, leaving the lines full (Fig. 45 B, 1). The plate is then passed through a powerful rolling-press with a sheet of thick, porous paper over it, which is forced into the lines, and takes the ink out of them, forming the impression (Fig. 45 B, 2). Instead of excavating the lines with a cutting tool, the plate may be covered with a preparation capable of resisting acids, known as etching-ground. The copper is then laid bare by scratching through the ground with a suitably-mounted needle. Diluted nitric acid is poured on the plate, and allowed to corrode the metal. When sufficient depth

is obtained, the acid is poured off. Those lines which are "bitten" sufficiently are filled up with varnish. The process of biting is then repeated until the deepest lines are sufficiently corroded. This process of *etching* is a great favourite with artists, and might, no doubt, be turned to account for microscopical purposes, as it is much easier than using the graver, which is a very troublesome tool. The disadvantage of plate printing is that the obtaining of impressions is expensive, and the number limited, owing to the rapid wear of the plate; this latter objection, however, may be overcome by copying the plate by electrotpe. The variety of engraving

FIG. 45.\*



known as mezzo-tint is well adapted for the representation of tissues; but it requires a skilled engraver, and the learning of it would take up too much of the observer's time.

*Surface printing* is the reverse of plate printing. In this, as will be seen (Fig. 45, A, 1), the light parts are excavated and the dark parts left standing; these receive the ink from the roller, and yield a copy to a sheet of paper upon pressure being applied (Fig. 45 A, 2). Common type is an example of this kind of printing. For art purposes, wood engraving is employed. The drawing is made on a block of box-wood, which is then placed in the hands of the engraver, who cuts away the light portions, leaving the solid black (if

\* "How to Work with the Microscope," pp. 28-35.

\* We are indebted for this woodcut to Messrs. Winsor and Newton.



any) standing, and variously modifying, by lines and dots, the portions which have a tone between black and white "half-tints." The process is a difficult one, requiring great skill, which is only to be acquired by very long practice. It is capable of rendering microscopical subjects with great perfection: the re-productions of Dr. Beale's drawings in his various papers, by Miss Powell, are marvels of delicacy. Some beautiful specimens of wood-engraving will also be found in the work on the microscope by the late Richard Beck. Wood-engraving has the advantage of being cheaply printed, and also of being set up along with type, although, in the latter case, its beauty is somewhat sacrificed: it never has justice done to it unless it is printed by itself, and with very great care. A valuable little book on the "Art of Wood-Engraving," by T. Gilks, is published by Messrs. Winsor and Newton.

(To be continued.)

#### ON THE

### ACTION OF BROMINE UPON ETHYLBENZOL.\*

By T. E. THORPE, Ph.D.

IN the course of an investigation upon ethylbenzoic acid, which Professor Kekulé and the author recently published, they had occasion to prepare a quantity of monobromethylbenzol,  $C_6H_4Br \cdot C_2H_5$ , the object being to prove, experimentally, the identity of the ethylbenzoic acid made synthetically by acting upon monobromethylbenzol by means of carbonic anhydride and sodium, with the acid subsequently obtained by Fittig by oxidising diethylbenzol by means of nitric acid. The authors, while preparing the bromide they required for their experiments, followed the directions given by MM. Fittig and König. The action of bromine upon ethylbenzol is very energetic, and the last-named substance has to be strongly cooled. The resulting product was submitted to fractional distillation; at  $145^\circ$  the liquid commenced to boil, and a comparatively large quantity passed over between  $150^\circ$  and  $160^\circ$ ; but the greater portion came over between  $180^\circ$  and  $190^\circ$ . An analysis of that portion showed it to contain very nearly the theoretical amount of bromine calculated for  $C_8H_9Br$ ; this compound is very unstable. On renewed distillation, it was found to begin to boil at  $140^\circ$ , and, unless the distillation is very rapidly conducted, a large proportion is transformed into styrol and hydrobromic acid; this difficulty is met, however, by distillation *in vacuo*. The bromide thus obtained is a heavy colourless liquid, boiling nearly constantly at  $148^\circ$  to  $152^\circ$ , and possessing a characteristic penetrating odour. When heated with solutions of ammonia or potassa in alcohol, it gives up its bromine with the greatest facility. The author points out the very great difference of properties discovered by him to exist between the monobromethylbenzol described by M. Fittig and that obtained by him and just alluded to, and reasonably concludes that these substances, although prepared under conditions apparently exactly similar, are not identical. The compound obtained by the author is identical with that obtained by Berthelot by acting upon boiling ethylbenzol with vapours of bromine, and the formula of that substance is  $C_6H_5 \cdot C_2H_4Br$ .

The larger portion of the contents of this paper is further devoted to the description of the experiments made to discover the cause of the variation in the position of the bromine atom. As the result of these experiments, some new substances were obtained; among these, styrolyl-ethyl-ether, a colourless, mobile, fragrant smelling liquid, boiling constantly at  $187^\circ$  (sp. gr. at  $21.9^\circ$ , 0.931), slightly

soluble in water, and burning with a strongly-luminous flame.

The author describes, at great length, the different operations and manipulations applied by him, but space forbids us to enter into more details on this subject.

#### ON THE

### SUPPOSED NUCLEATE ACTION OF WEAK SOLUTIONS OF GLAUBER'S SALT

#### ON

### SUPERSATURATED SOLUTIONS.

By CHARLES TOMLINSON, F.R.S.

A GENTLEMAN, under the signature of "A Constant Reader of the CHEMICAL NEWS," has written to me respecting my theory of the action of nuclei on supersaturated solutions,\* and states that this theory does not meet the case given by M. Jeannel,† in which a supersaturated solution (say of Glauber's salt) filtered into a flask, is protected by leaving the funnel and the filter in the neck of the flask; so that when cold, an ordinary solution of the same salt being poured upon the filter, produces crystallisation as soon as it reaches the supersaturated solution.

The objection is—(1) that, in such a case as this, there can be no nucleus derived from the air, and (2) that the liquid which causes the solution to crystallise is chemically clean.

While engaged in studying the subject of supersaturated solutions, I read M. Jeannel's paper with much interest, and repeated his experiments with such variations as the nature of the case seemed to require. My conclusion was that, if the experiment be conducted with proper attention to cleanliness and care to exclude nuclei, a solution of Glauber's salt may be allowed to fall upon a cold supersaturated solution of the same salt without inducing crystallisation.

So long as I adopted M. Jeannel's form of experiment, I always obtained his result—namely, a separation of the salt from the supersaturated solution. But this form is objectionable, because, by leaving the funnel and filter exposed during many hours to the air, active nuclei become accumulated on it, and some of them are sure to be dragged down with the solution into contact with the contents of the flask. In like manner, a crystal taken up between the finger and thumb, or even by mere exposure to the air, is said to be an active nucleus in crystallising a supersaturated saline solution of its own kind; but I have already proved‡ that, if care be taken to make the crystal chemically clean, it is possible to bring it into contact with a highly-supersaturated solution, and to leave it there for days, and even months, without any separation of the salt.

M. Jeannel's position is that drops of a solution of a salt, allowed to fall upon a supersaturated solution of the same salt, will cause it to crystallise. In testing such a proposition, I am, of course, allowed to adopt my own means for conveying the drops to the solution, and, provided they reach it and fall upon it, the case is met, even though the funnel and filter be dispensed with.

My method of conducting the experiment was this:—A solution of Glauber's salt was filtered into a clean flask, in which it was boiled up again; and, while boiling, a clean, straight dropping-tube, closed by means of a cork at the top, and passing through a disc of vulcanised india-rubber, was put into the flask, so that its point dipped below the surface of the solution. The heat expanded the air of the tube, and a considerable quantity of it

\* Abstract of a paper communicated to the Royal Society.

\* CHEMICAL NEWS, vol. xix., p. 267.

† *Ann. de Ch. et de Ph.*, 4 Ser., t. vi., p. 166.

‡ CHEMICAL NEWS, vol. xviii., p. 110.



escaped in bubbles. When the lamp was removed, an equal volume of the solution entered the tube, which was then pulled up about an inch, so as to be out of, but over, the solution. The india-rubber disc protected the solution from the entrance of nuclei, but, as a further precaution, each flask was covered with a bell-glass. In this way, the solutions can be kept as long as may be required without crystallising. On taking off the bell-glass and gently loosening the cork (a stop-cock would have been better), the solution fell from the tube in drops, but there was no separation of salt.

Two solutions were next made, the one containing 1 part of salt to 1 of water, and the other 2 parts of salt to 1 of water. Each flask contained a tube, passing through an india-rubber disc, as before; and, when the tubes had taken up a quantity of the solution, they were changed—that is, the tube containing 1 salt to 1 water was put into the flask containing 2 salt to 1 water, and *vice versa*. When the solutions were cold, the corks were loosened. The drops produced much disturbance in the internal viscosity of the solutions, but there was no crystallisation.

In another experiment, the solution containing 1 salt to 1 water was allowed to drop into a solution containing 3 salt to 1 water, and this into the solution of 1 salt to 1 water. The solutions were prepared over night, and, as the night was cold, the flasks, as well as the tubes, contained portions of the modified salt, so that crystals, as well as drops fell into the solutions; but still the solutions did not crystallise: on taking out the tubes, they did so immediately, the nuclei being, of course, derived directly from the air.

A still weaker solution (namely, 1 salt to 3 water) was allowed to drop into a supersaturated solution containing 2 salt to 1 water; but there was no separation of salt.

Hence it will be seen that, if proper precautions be taken to exclude nuclei, a solution of Glauber's salt does not act as a nucleus to a supersaturated solution of the same salt.

Supersaturated solutions of potash-alum, treated in the same way, lead to the same result. I have no doubt that similar solutions of other salts would lead to the general conclusion that solutions of salts do not act as nuclei to their supersaturated solutions.

Highgate, N., Jan. 29th, 1870.

## ON THE DECOMPOSITION OF SALTS OF SESQUIOXIDE OF IRON.

By M. H. DEBRAY.

If a solution of neutral chloride of sesquioxide of iron, so much diluted that its colour is scarcely perceptible be heated, the liquid will be seen, after arriving at 27°, to become strongly coloured and assume the characteristic hue of sesquioxide of iron. This change is not owing to the evolution of a certain quantity of chlorhydric acid, for it is effected in close vessels, and, after cooling, the liquid retains its primitive acid reaction and the colour which it has received from the heat.

The chemical properties of the salt of iron are greatly modified: the original liquid gives with yellow cyanide a precipitate of a deep Prussian blue colour, whilst the coloured solution with the same reagent yields only a pale greenish blue precipitate, and saline solutions of sea-salt for instance, without acting on the ordinary chloride, produce in the modified chloride a gelatinous precipitate of hydrated sesquioxide of iron. This oxide when immediately washed re-dissolves in the water and contains only small quantities of salt, but it loses the property of solubility if it be allowed to digest a day or two with its precipitant. The modified solution when dialysed gives

chlorhydric acid almost entirely exempt from iron, which passes through the paper and from soluble oxide of iron which remains in the dialyser.

The chloride of iron separates at about 70° into chlorhydric acid and sesquioxide of iron, soluble in water and in diluted chlorhydric acid, insoluble in most saline solutions: these are precisely the characteristics of colloidal oxide of iron obtained by Mr. Graham in the dialysis of basic solutions of iron.

It is not supposed that chloride of iron separates into chlorhydric acid and basic chloride, because the existence of these basic soluble compounds appears scarcely reconcilable with the fact of their decomposition by the septum in dialysis, or by the sea salt which precipitates pure oxide of iron.\* It would seem more natural to consider these compounds as solutions of colloidal oxide of iron in chlorhydric acid, or, at least, in common sesquichloride of iron.

On heating on a water-bath at 100° a diluted solution of sesquichloride of iron, and carefully replacing the evaporating liquid, the soluble oxide is gradually changed into the isomeric modification of sesquioxide of iron discovered by Pean de Saint-Gilles. It will be remembered that this chemist by subjecting acetate of sesquioxide of iron in solution to the prolonged action of heat obtained a particular oxide insoluble in dilute mineral acids and in most alkaline solutions, and yielding, when mixed with water, a liquid transparent to transmitted light and turbid on reflection.

Some years later, M. Scheurer-Kestner demonstrated that the decomposition of nitrate of iron would also furnish it. According to my experiments, the production of Pean de Saint Gilles's oxide is due to the same cause. The first effect of heat upon salts of iron with monobasic acid is to separate them into acid and oxide, which only remain separate if the acid is diluted; the next is to transform the soluble oxide into the metasesquioxide of Pean de Saint-Gilles, which differs by its state of hydration and by several of its characteristics from the colloidal oxide of Mr. Graham. Solutions of bibasic acids, like the sulphate, yield only insoluble subsalts when submitted to the action of heat.

If De Senarmont's method be used, namely, by decomposing chloride in a diluted solution at a temperature varying from 250° to 300°, at which colloidal oxide and metasesquioxide no longer exist, the separation of the acid and oxide necessarily occur, since a temperature of 70° only suffices to effect it. The oxide, which is produced very slowly, is anhydrous sesquioxide and crystallised, that is to say, oligistic. It is unnecessary to explain the experiment of De Senarmont to introduce the influence of pressure upon the closed tube in which the experiment is made by steam strongly heated, or by an evolution of chlorhydric acid.

Iron may be separated from manganese by a well-known method, as follows:—First transform the metals into chlorides; then bring the iron to the maximum of oxidation; and, after incompletely saturating the excess of acid by carbonate of soda, an excess of acetate of soda is added to the boiling liquid. The sesquioxide of iron is precipitated alone in the acid liquid. The theory of this reaction is very simple. The acetate of sesquioxide of iron, formed of a mixture of chlorides and acetate of soda, separates, on boiling, into acetic acid and colloidal oxide, insoluble in a liquid containing a notable quantity of sea-salt and acetate of soda. When washed quickly in cold distilled water, a large portion of the oxide re-dissolves; this may be avoided by washing it with a diluted solution of chlorhydrate of ammonia. It will also be easy to introduce into the liquid containing the chlorides only volatile reagents, acetate of ammonia, which produces the same effect as acetate of soda, because colloidal oxide of iron is insoluble in an ammoniacal salt, even in the

\* This reaction of alkaline chlorides on basic chlorides was noticed for the first time by M. Béchamp (*Ann de Ch. et Phys.*)



presence of a large quantity of acetic acid. The separation of oxides of iron and manganese is as perfect as possible by this method; but it is preferable for exactitude in weighing the oxide of iron to pour the solution of acetate of ammonia into a hot solution of nitrates of the two bases, and to wash the oxide with a warm solution of nitrate of ammonia. The loss of iron consequent upon the action of the ammoniacal salt upon oxide of iron during calcination is thus avoided.

Aniline is actually prepared (after M. Béchamp's method) with nitrobenzol, iron, and a quantity of acetic acid much smaller than that of the quantity of sesquioxide formed. The acetate of peroxide of iron, having but little stability at the comparatively high temperature of the reaction, is decomposed into insoluble sesquioxide of iron, and into acid capable of again reacting on the metal. A small quantity of acetate of aniline should also be formed; but, if the tension of dissociation of this salt is sensible at the temperature of the experiment, it necessarily follows that a small quantity of acid will suffice to terminate the reaction.—*Comptes Rendus*.

### ON THE SEPARATION OF IRON AND ALUMINA.

By E. W. PARNELL.

Of the many methods proposed for the separation of iron and alumina effectively, no one seems to combine the very necessary qualities of accuracy and simplicity. The method of weighing the two oxides together, and then separating the alumina by fusion with caustic soda and subsequent treatment with water, is, no doubt, exceedingly accurate, but troublesome. In an accurate analysis, an analyst avoids, if possible, volumetric estimations. The plan of effecting the separation of the iron by means of sulphide of ammonium from the ammonio-citrate solution of the oxides cannot give perfectly accurate results, since the sulphide of ammonium has the power of holding up small quantities of iron in solution; this may be proved by letting the perfectly-clear filtrate stand a few days, when small flakes of sulphide of iron will be deposited.

The method about to be described (proposed, I believe, by Prof. Bunsen, of Heidelberg) is in use in some laboratories on the Continent. I have never seen it published in English, and it may possibly be new to some of your readers. To the slightly acid solution of the oxides a solution of hyposulphite of soda is added, more than equivalent to the amount of free acid present. The liquid is then boiled in a flask for about ten minutes or a quarter-of-an-hour. The whole of the alumina will be thrown down in a fine granular state, together with the sulphur resulting from the decomposition of the hyposulphurous acid; while the whole of the iron will remain in solution. The liquid is then rapidly filtered, and the precipitate washed with boiling water, dried, ignited in a porcelain crucible, and weighed in the usual manner. The filtrate containing the iron is treated with hypochlorite of soda, nitric acid, or other oxidising agent, and the iron estimated by precipitation by ammonia and weighing as sesquioxide. Care should be taken to avoid large excess of acid, in the first instance, and also, subsequently, of the hyposulphite: the smaller the proportion of sulphur with the precipitated alumina, the more easily may it be filtered off from the iron solution. After calcination, the alumina appears as a perfectly-white, crystalline powder, much resembling precipitated and calcined silica.

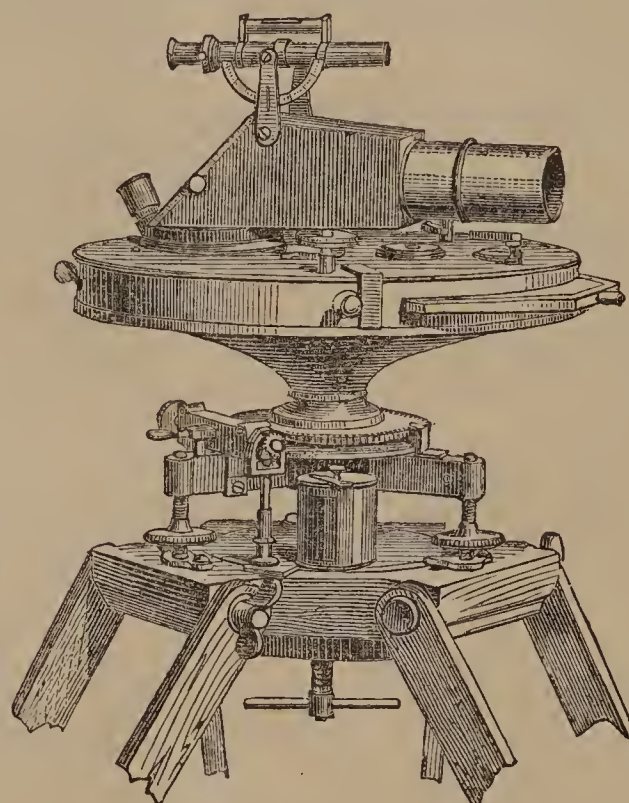
Alumina might probably be separated by this method from other metals—such as manganese, zinc, &c.; and, were phosphoric acid present, it would probably be carried down with the alumina. I have not, however, experimented on these points.

Runcorn Soap and Alkali Works,  
Runcorn, Jan. 27th, 1870.

### PHOTOGRAPHIC PLANE-TABLE.

WE have received through the kindness of Mr. James Swaim, a pamphlet on the above instrument, invented by M. Auguste Chevalier, containing full descriptions of its working and construction, and illustrated by engravings and a photograph.

The accompanying woodcut represents an exterior view of the apparatus as given by the photograph. It consists of a photographic objective, behind which is placed a square prism, by total reflection from whose oblique rear surface, the image formed by the lens is projected upon an horizontal sensitive plate set beneath. The lens and prism, as well as an opaque screen covering the plate with the exception of a narrow slit in a plane passing through the axis of the lens and the centre of motion, rotate about a vertical axis in the middle of the instru-



ment, being driven by appropriate clock-work. By this means, when the instrument is placed at one end of a base line, adjusted, furnished with a sensitive plate, and allowed to make a total revolution, it will produce an automatic photographic horizontal projection of all objects within the panoramic field, from which their various angular relations may be determined with the greatest accuracy. It might seem that sharpness of definition was incompatible with a continuous motion of the lens, but the admirable panoramic pictures produced by the apparatus of Martens and of Garella, which operate on the same principle, are a complete and satisfactory answer to this objection.—*Journal of the Franklin Institute*.

### ON BAUME'S AREOMETER.

By M. BAUDIN.

SUNDRY divergences occur in Baumé's areometer, according to different authors. Upon examining this instrument, I found the figure given for 85 parts of distilled water and 15 parts of pure and well-dried chloride of sodium to be 1.111 absolute density at 15°. Francœur found 1.109; Soubeiran, 1.116; Terlach, 1.114; and M. Coulier, Professor of Chemistry, gives 1.110725. The work of the latter may be considered as the most important of those upon the subject.

Repeated experiments have convinced me that the figure of density 1.111 is most correct; I have, therefore, employed it to re-construct the actual scale of Baumé.



The figure 1.116, given by Soubeiran, does not correspond with Baumé's formula (85 parts of water and 15 of salt), and indicates that the instrument marks 66° in a sulphuric acid whose point of concentration is undefined: this arbitrary scale is by no means that of Baumé. Serious results arise from these discrepancies—manufacturers are uncertain as to which Baumé-areometer they should trust, and endless disputes ensue. Brisson's densimeter should be the only one employed, as anyone can manage it.

*Comparison of Baumé's Scale (Acidimetric) with the Scale of Density.*

Baumé. Degrees.	Francœur. Density.	Baudin. Density.	Soubeiran. Density.
0 .. ..	1000	1000.0	1000
5 .. ..	1034	1034.4	1036
10 .. ..	1070	1071.3	1075
15 .. ..	1109	1111.0	1116
20 .. ..	1151	1153.8	1161
25 .. ..	1196	1200.0	1210
30 .. ..	1245	1249.9	1262
35 .. ..	1299	1304.2	1320
40 .. ..	1357	1363.5	1383
45 .. ..	1420	1420.4	1453
50 .. ..	1490	1500.0	1530
55 .. ..	1567	1578.9	1615
60 .. ..	1652	1666.6	1711
65 .. ..	1747	1764.6	1819
70 .. ..	1853	1875.0	1942

## NOTICES OF BOOKS.

*Our Domestic Fire-places.* A New Edition, entirely Rewritten and Enlarged, the Additions completing the Author's Contributions on the Domestic Use of Fuel, and on Ventilation. By FREDERICK EDWARDS, jun. London: Longmans, Green, and Co. 1870.

THIS work treats on a most important subject, since it is one of the more difficult things in domestic economy to utilise fuel well, and to derive from it the greatest benefit with the least expenditure of combustible matter.

The work before us is divided into four chapters, and to each of these are added a series of lithographed plates for illustration. The first chapter treats chiefly on the history of fire-places and the substitutes in use even at comparatively recent times. We find recorded at page 5 that, at as late a period as the end of last century, before the introduction into England of the system of heating by hot-water circulation and by close stoves, large areas (including the Chamber of the House of Commons) were heated by charcoal or coke, burned in the open brazier. The second chapter gives a short account of the improvements in fire-places which have been effected during the present century. The third chapter treats on the improvements to be still effected in the domestic fire-place, and on the means for better diffusing the heat of the open fire-place, and thereby avoiding inequalities of temperature in the apartment. Under this heading, eight sub-sections are introduced, viz.—(1) By using the best form of grate; (2) by using the most suitable materials for the construction of the grate; (3) by improving the fire-bars; (4) by using the fire within a chamber of firebrick and checking the supply of air from below; (5) by checking the escape of the warm air of the room into the chimney; (6) by giving a supply of air in proximity to the fire-place, instead of from doors and windows; (7) by doubly-glazing the windows—(As regards this particular, anyone acquainted with the Continent must wonder at the fact that the mansions and abodes of the better classes are not more generally provided with double windows: this is a

very frequent occurrence on the Continent, and contributes largely to retain the heat generated by fire-places; (8) by utilising the heat which escapes from the chimney. The fourth chapter is entirely devoted to the description of stoves, calorifères, and the various modifications thereof, and to such subjects as heating by hot water, hot air, and steam.

We regret that space forbids us to enter into even one or two of the many interesting details this work contains. It bears on every page the mark of careful research, and abounds to such an extent with useful matter that we should desire to see it studied and its contents brought into actual practice by all those who are in any way concerned with the important branch of domestic economy on which it treats.

As is usual with the eminent firm who published the work, its execution leaves nothing to be desired.

*The Body and its Health; a Book for Primary Schools.* By E. D. MAPOTHER, M.D., &c. Dublin: John Falconer. London: Simpkin, Marshall, and Co. Pp. 127.

It is an excellent sign of the increased desire of knowledge such as is contained in this little book, as well as of the excellence generally speaking of its contents, that the first edition was, as we learn from the brief preface, sold off in three days. *De tous les capitaux celui dont le peuple est le plus prodigue est leur santé* was long ago said by an eminent French savant. Health is wealth; and whatever promotes the first is highly conducive to the latter. How can we expect the "*mens sana in corpore sano*" where that *corpus* is neglected through sheer ignorance?

This book is filled with really useful knowledge, and treats on subjects of the highest importance. We have here an epitome of anatomy, physiology, dietetics, and hygiene rendered accessible, and easily comprehended by the young readers it is intended for. Interspersed through the context, we meet with a great many brief facts relating to chemistry, which, since they are applied in a proper manner, are very useful; although on page 42, we think the reason given for the purity of sea and country air as being due to ozone, is one for the truth of which no sufficiently reliable data have as yet been found. Sea air undoubtedly contains some chlorine and always finely-divided, almost-pulverised salts. Country air owes much, if not all, of its purity to its freedom from dust and smoke, the effects of meadows, and trees, and growing crops; to the absence of high buildings, the lesser impediments of free circulation; and last, but not least, to freely-running brooks and water-courses.

The book is very well illustrated with a number of woodcuts; and it is not only excellent for the youth, but many full-grown people may be taught a useful lesson by its perusal.

*The Pharmacopæias of the London Hospitals.* By PETER SQUIRE, F.L.S. London: Churchill and Sons.

*The Pocket Guide to the British Pharmacopæia.* London: Hardwicke.

MR. SQUIRE's well-arranged and capably-printed book must prove of great service to the doctors. Arranged in groups for easy reference and comparison, it contains the pharmacopæias of seventeen London hospitals, and thus serves as a standard of the therapeutical practice of the present time.

The "Pocket Guide" seems to comprise the essentials of the "British Pharmacopæia," conveniently arranged in a small compass for the busy practitioner to carry handily.



## CORRESPONDENCE.

## COLOPHONIC HYDRATE.

*To the Editor of the Chemical News.*

SIR,—Observing in the CHEMICAL NEWS (vol. xx., p. 38) Mr. Tichbourne's account of colophonic hydrate, it may be worth while mentioning the result of an analysis which I made shortly before leaving England, in 1866.

Some white, needle-shaped crystals that had formed in an old sample of rosin-spirit were purified by sublimation and submitted to combustion. 0.112 grm. gave 0.239 CO<sub>2</sub> and 0.112 H<sub>2</sub>O.

	Found.	(C <sub>10</sub> H <sub>16</sub> +4H <sub>2</sub> O).
Carbon .. ..	58.19 .. ..	57.70
Hydrogen.. ..	11.11 .. ..	11.53
Oxygen .. ..	30.70 .. ..	30.77
	100.00	100.00

The crystals fused below 100° C. They were soluble in water and neutral.

I observed, about the same time, that crystals of a similar appearance quickly formed in rosin-spirit which had been distilled in a current of steam.—I am, &c.,

ALEXANDER M. THOMSON.

University, Sydney, N.S.W.,  
Dec. 2nd, 1869.

REACTIONS OF DISULPHIDE OF CARBON  
WITH BARIC AND CALCIC HYDRATES.*To the Editor of the Chemical News.*

SIR,—In Watts's "Dictionary" (vol. i., p. 776) the reactions of disulphide of carbon with the fixed caustic alkalies are given, but those with baric and calcic hydrates are omitted, nor are they to be found in any of the addenda. I have, therefore, thought that perhaps the following notes might be worth insertion.

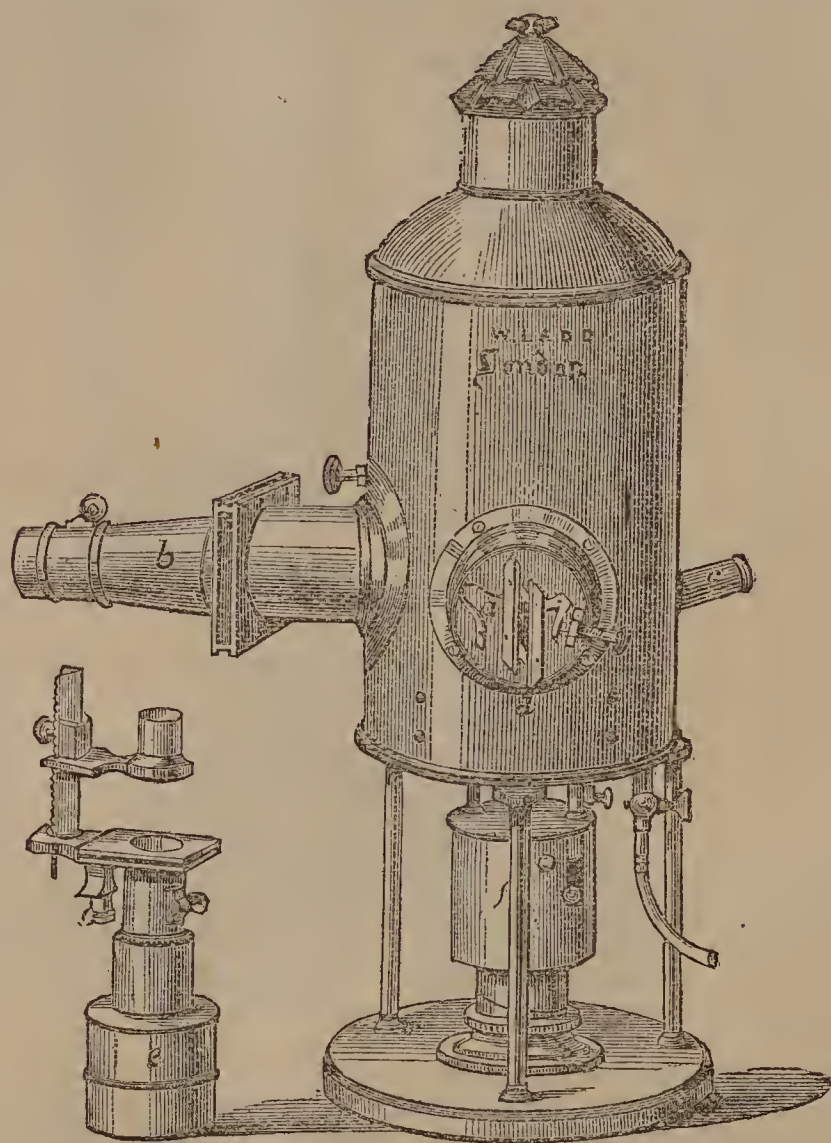
A solution of baric hydrate, agitated with carbonic disulphide, rapidly turns to a dark purplish brown colour, changing to a dirty green, and, lastly, to a brownish yellow solution with a small quantity of dark brown deposit, this final result being precisely similar to that obtained after a much longer period of time with sodic or potassic hydrate, as, in the time required to produce the purplish brown colour with the baric hydrate, a pale brownish yellow only could be obtained with the sodic or potassic hydrate. A solution of calcic hydrate with carbonic disulphide produces, after long stirring and standing, only a pale brownish yellow solution, a result to be expected from the inferior solubility of the calcic to the other hydrates. The reaction is, of course, similar in all cases, viz., the formation of carbonates and sulpho-carbonates.—I am, &c.,

HENRY MATHEWS.

## MISCELLANEOUS.

**Improved Electric Lantern.**—Since spectrum analysis has been discovered a great inconvenience has been felt by lecturers in being compelled to use two lanterns—one for exhibiting the spectrum, and the other to project on the screen a direct ray of light, a photograph, or other object. When only one lantern was used it was requisite to disconnect the apparatus, and revolve the lantern in order to project the object on the screen, and as it has been found inconvenient to show all the spectrum experiments together, and diagrams, &c., afterwards, the loss of time in getting the prisms and lenses to their required position, and re-adjusting the lantern, is considerable. These

inconveniences Mr. Ladd has entirely overcome by his new form of lantern, which is provided with two openings—one placed facing the screen, and the other at an angle of about 100° from it, this being about the proper angle when two prisms containing bisulphide of carbon are used for producing a spectrum. But as the angle must vary, according to the distance from the screen, one of the openings is provided with an adjustment for that purpose. The lantern is also provided with a small opening at the back, at the same height as the other two, for the reception of a sliding tube, carrying a lens at one end which focuses on a piece of ground glass at the other an image of the carbon



points. This enables the operator not only to see what is going on at the points, but also to keep them at an exact height, so requisite in many experiments. As an example of the utility of this arrangement, we will suppose the operator wishes to project on the screen an image of the arc as well as the spectrum of any particular substance; to do this he closes the slit, and focuses the arc by means of the optical arrangement facing the screen, and while the metal is still burning he closes this opening and opens the slit, when immediately a spectrum of the substance appears in the same part of the screen. The lantern is entirely of metal, and is also provided inside with a gas-jet and stopcock to enable the operator to perform his work in a darkened room.

**Correlation of Vital and Physical Forces.**—Preliminary trials having shown that any change of temperature within the skull was soonest manifested externally in that depression which exists just above the occipital protuberance, a pair of these little (thermoelectric) bars was fastened to the head at this point; and to neutralise the results of a general rise of temperature over the whole body, a second pair, reversed in direction, was attached to the leg or arm, so that if a like increase of heat came to both, the electricity developed by one would be neutralised by the other, and no effect be produced upon the needle, unless only one was affected. By long practice it was ascertained that a state of mental torpor could be produced, lasting for hours, in which the needle remained stationary. But let a person knock on



the door outside the room, or speak a single word, even though the experimenter remained absolutely passive, and the reception of the intelligence caused the needle to swing through 20°. In explanation of this production of heat, the analogy of the muscle at once suggests itself. No conversion of energy is complete; and as the heat of muscular action represents force which has escaped conversion into motion, so the heat evolved during the reception of an idea, is energy which has escaped conversion into thought, from precisely the same cause. Moreover, these experiments have shown that ideas which affect the emotions, produce most heat in their reception; a few minutes recitation to one's self of emotional poetry, producing more effect than several hours of deep thought. Hence it is evident that the mechanism for the production of deep thoughts, accomplishes this conversion of energy far more perfectly than that which produces simply emotion. From a Lecture by Professor G. F. Barker, before the American Institute, reported in the *Scientific American*.

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

*Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

*Comptes Rendus des Séances de l'Académie des Sciences, January 17, 1870.*

This number contains the following papers and memoirs relating to chemistry and allied sciences:—

**General Theory of Chemical Action and the Necessity of its Introduction and Use to Prevent Errors being made.**—M. Maumené.—This paper was read, but is not published. From an account of the meeting at hand, we learn that this very revolutionary chemical paper, containing direct attacks upon the most eminent living, as well as deceased, authorities of chemical science, has been remanded to the section for chemistry.

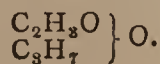
**Dispersion of Light.**—M. Ricour.—A continuation of a former paper on this subject, and strictly algebraico-physical.

**Some Silicified Vegetables met with near Autun.**—M. Regnault.

**Nickelisation.**—M. Gaiffe.—The author states, in a letter read at the meeting by M. Dumas, that he desires to call the attention of the members to a variety of objects electro-nickelised, sent to the place of meeting. He also calls attention to the fact that the presence of even the smallest quantity of potassa, or soda, or alkaline earths in the bath containing the nickelising preparation is injurious to effect a properly-adhesive coating of the metal. The use of perfectly pure double chloride of nickel and ammonium, or of perfectly pure sulphate of nickel and ammonium, and, moreover, of pure nickel, as one of the electrodes is required. By these means, the nickel is made to adhere regularly and strongly, and only requires polishing after the metal coated over is taken from the bath.

**Spectra of the Simple Gases.**—M. Wüllner.—This paper is a defensive reply from the author against the remarks made by M. Dubrunfaut on his former paper concerning this subject.

**Synthesis of Normal Propylic Alcohol by means of Ethylic Alcohol.**—M. Rossi.—The author converts chloride of ethyl into cyanide of ethyl, and next converts that cyanide, by means of well-known methods, into propionic acid. From the lime-salt of that acid propionic aldehyde is obtained; this is a clear, very mobile liquid, soluble in water, exhibiting a suffocating odour, boils at 49.5°; at 740 m.m. barom., sp. gr. at 17°, 0.804; formula, C<sub>3</sub>H<sub>6</sub>O. By hydrogenising this aldehyde, the propylic alcohol is obtained. After having been purified, this liquid exhibits the following properties:—Boils at 96°; barom., 743 m.m.; sp. gr. at 0°, 0.8205; formula, C<sub>3</sub>H<sub>8</sub>O. The author describes, at some length—Bromide of propyl, C<sub>3</sub>H<sub>7</sub>Br; iodide of propyl, C<sub>3</sub>H<sub>7</sub>I; cyanide of propyl; acetate of propyl—



January 24, 1870.

This number contains the following memoirs and papers relating to chemistry and allied sciences:—

**Electro-Depositing of Nickel upon Other Metals.**—M. Becquerel.—Eight years ago, the author applied, for the purpose of electro-deposition of nickel upon other metals, the same method as described at the previous meeting by M. Gaiffe and his associates. M. Becquerel now states that, since the last meeting, he has purposely repeated some of his former experiments, with the express view of ascertaining whether the statement made by M. Gaiffe, concerning the injurious action of the presence of potassa be correct or not. The result of experiments is that the presence of potassa is not at all injurious to, and in no wise affects, the deposition of nickel, since the double sulphate of nickel and potassa can be applied, as well as the double sulphate of nickel and ammonia; but if the positive electrode is not made of nickel, it is necessary to add free ammonia, in order to saturate the sulphuric acid which is set free.

**Election of a New Corresponding Member.**—M. Kirchhoff has been elected corresponding member, in lieu of Mr. Forbes, deceased.

**Discovery of Diamond at Dlaschkowitz (Bohemia).**—M. Schafaritz.—At 60 kilometres (37.26 English miles) north-west from Prague, in a mining district belonging to Count Schönborn, a stone was found a few weeks ago, which, on having been forwarded for assay to the Polytechnic School at Prague, turned out to be a diamond. Its weight is 57 milligrams; sp. gr., 3.52; its shape, irregular; its crystalline form, a rhomboidal dodecahedral. This discovery is interesting in more than one respect—in the first place, this specimen is the first genuine diamond found in Europe (the Ural mountains produce diamonds, but not on European territory); secondly, because of the geological formation wherein this specimen occurred, a formation quite different in character from that wherein diamonds have been found hitherto in other parts of the world. The locality alluded to is stated by the author to yield several other kinds of precious stones.

**Constitution of Luminous Spectra.**—M. Lecoq de Boisbaudran.

**Freezing of Water, and on Saturated and Non-Saturated Gaseous Solutions.**—M. Barthélemy.—This paper contains the description of some experiments made with the view to explain some irregularities observed by the author when ice was formed at -10° or -12° under peculiar conditions. The author states that, as result of his experiments, the so-called, or, rather, averred explosive force of ice is untenable and does not agree with its plasticity, and that the gases contained in the water, becoming liberated and compressed by the formation of ice, are the cause of the explosive action of that material.

**General Theory of Chemistry; Preparation of Oxy-Ammonia.** M. Maumené.—The author's chief aim is to explain, by a peculiar theory of his own invention, certain reactions which take place when nitrate of ammonia, or other alkaline nitrates, are acted upon by nascent hydrogen. 200 grms. of nitrate of ammonia are mixed with 2170 grms. of hydrochloric acid (sp. gr., 1.12) and 552 grms. of tin, and care taken to keep this mixture in a very cool flask or retort. After the action is finished, the fluid is treated with sulphuretted hydrogen, next, some alcohol is added, and also some chloride of platinum. After proper purification, a substance is obtained which is soluble in absolute alcohol, and containing 52.6 per cent of hydrochloric acid; mixed with oxide of copper, this substance yields deutoxide of nitrogen. When pure chloride of ammonium is acted upon by a solution of nitrate of silver, care being taken to leave a slight excess of the former salt—in this sense, that there be not enough nitrate to decompose the chloride entirely, there is formed (after filtration, of course) a liquid which, concentrated by evaporation to a syrupy consistence, deposits a peculiar salt, which, at a comparatively low temperature, gives off deutoxide of nitrogen.

**Variable State of Electric Currents, and on Extra Currents.**—M. Blaserna.

**Experiments on the Intrapolar Currents of a Grove Element.**—M. Royer.

**Nature of Ozone.**—M. Dubrunfaut.—We shall return to this paper.

**Improvement of Wines by Electricity.**—M. Scoutetten.—The author states, in the first place, that a series of experiments, made on the large scale and with various sources of electricity, led to the result that electricity, under whatever form applied (whether as a regular current or a succession of discharges accompanied by sparks), improve wine, rendering it mellow and mature. As to the mode of action of this agent, the author thinks that the bitartrate of potassa present in wine is decomposed: the potassa set free saturates the acids of the wine, and the free tartaric acid, reacting upon the fatty matters present, favours the formation of the ethers which constitute the bouquet of the wine. Moreover, a small quantity of water is decomposed, and the oxygen thereof reacts upon some of the constituents of the wine, thereby forming new compounds which are peculiar to old wines.

Cosmos, January 22, 1870.

**Artificially-Prepared Alizarine.**—The Société Industrielle de Mulhouse has just proposed to grant its medal of honour to him who shall introduce artificially-made alizarine at a sufficiently low price, so that it may be available for general use, instead of and to perfectly answer all the purposes to which madder or its preparations are now applied in calico-printing and dyeing. The competitor is bound to make and deliver a quantity of this product equal to, at



the least, 40,000 kilos. (40 tons' weight) of madder; the product, moreover, must be such that, by the methods of mordanting, &c., now in use, it will yield the same shades of colour and of the same good quality as madder or its preparations. This notice also states—(1) That the artificially-made alizarine prepared by MM. Meister, Lucius, and Co., at Hoechst, near Frankfort, yields, especially for red and puce, results which leave nothing to be desired. (2) M. Pernod, from Avignon,\* have just requested MM. Steinbach and Rack, of Mulhouse, to report upon the tinctorial value of a sample of a newly-discovered pigment extracted from the wash-waters of the madder while being converted into garancine; the same gentlemen have also been requested to report upon a sample of oxalic acid obtained from the same source.

**Detection of Butyric Acid in Glycerine.**—M. Pérutz.—According to the author, concentrated glycerine should simply be mixed, for this purpose, with very strong alcohol and concentrated sulphuric acid, when butyric ether is at once formed and easily recognised by its peculiar pine apple-like smell. Since glycerine often contains large quantities of butyric acid, the author proposes to treat with alcohol the animal charcoal employed for the decolouration of the glycerine; the butyric acid is retained between the pores of the animal charcoal in the state of butyrate of lime soluble in alcohol. The material thus recovered may be applied to the manufacture of butyric ether or butyric acid.

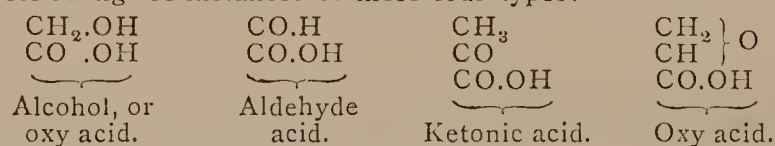
January 29, 1870.

**Gold Found in the Rivers of the Scandinavian Peninsula.**—M. Meunier.—The quantity of gold dust occurring among the sand of the beds of the northern rivers of Sweden and Norway is larger in quantity than has been hitherto generally known; three men have made, within six weeks, a sum of £80 each, by washing the sand and collecting the gold contained therein of one of the rivers.

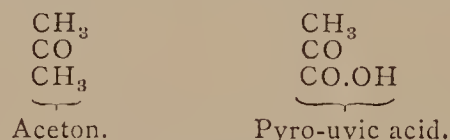
*Annalen der Chemie und Pharmacie*, December, 1869.

This number contains the following original memoirs and papers:—

**Ketonic Acids.**—M. Wichelhaus.—The intention of the author is to point out the limits, and reduce to regular classification the products of the oxidation of hydrocarbons. There are four different modes by means of which an atom of oxygen can combine with a hydrocarbon (provided the relative position of the carbon atoms remains unaltered). The following are instances of these four types:—

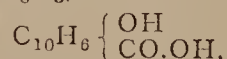


The paper next contains the following separate sections:—Relation of pyro-uvic acid and acetone—



(pyro-uvic acid bears the same relation to acetone as propionic acid to propan); products of the action of bromine upon pyro-uvic acid; substitution products of bibromo-pyro-uvic acid; distillation of pyro-uvates.

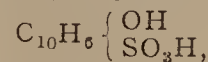
**Naphthol and Carbonaphtholic Acid.**—M. Eller.—When diazo-naphthaline prepared by means of the action of nitrous acid upon naphthylamine, is boiled with water, naphthol,  $\text{C}_{10}\text{H}_7\cdot\text{OH}$ , is obtained; but this mode of preparing naphthol, although modified in various ways by the author, only yielded traces of the substance alluded to. The author, therefore, considered it better to prepare naphthol by means of the decomposition of naphthaline sulpho-acid salts by fusing caustic potassa. The fused mass is first dissolved in water, decomposed by means of hydrochloric acid, and, after a further purifying process, naphthol is obtained as snow-white brilliantly-crystalline solid substance, fusing at  $92^\circ$ ; formula,  $\text{C}_{10}\text{H}_8\text{O}$ . When naphthol is acted upon by sodium and carbonic acid, it yields a new product, carbonaphtholic acid,  $\text{C}_{11}\text{H}_8\text{O}_3$ , or—



a solid substance, hardly soluble in water, readily so in benzol, ether, and alcohol, and fusing at about  $187^\circ$ . The salts of this acid are all rather difficultly soluble in water.

**Isomeric Naphthols and some Derivatives thereof.**—M. Schaeffer.—In the introduction to this paper, the author refers, at some length to the researches on this subject, first and foremost of Faraday, and next of MM. Liebig, Regnault, Berzelius, Wöhler, and many others. There exist— $\alpha$  naphthol,  $\text{C}_{10}\text{H}_7\cdot\text{OH}$ , obtained from naphthalin-sulphate of lead; this  $\alpha$  product is characterised by its behaviour with hydrochloric acid; for, if a splinter of fir-wood is dipped, first into an aqueous solution of  $\alpha$  naphthol, and then in hydrochloric acid, and then exposed to sunlight, the wood is first coloured green, and at last a brownish red colour.  $\beta$  naphthol also exhibits this reaction, but it is more rapidly performed; and when the wood is dipped afterwards in a weak solution of bleaching powder, a yellow tinge is produced. The author describes, at length, naphthol-ethyl ether,

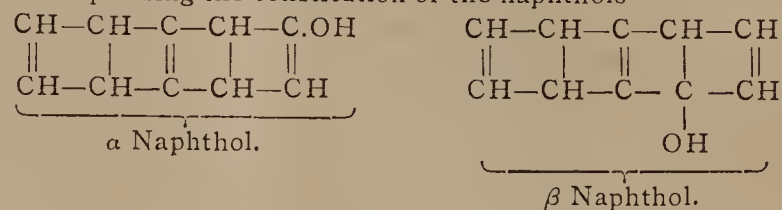
$\text{C}_{10}\text{H}_7\cdot\text{OC}_2\text{H}_5$ ; naphthol-ether,  $\text{C}_{12}\text{H}_{12}\text{O}$ ;  $\alpha$  and  $\beta$  naphthol-acetyl-ether,  $\text{C}_{10}\text{H}_7\cdot\text{OC}_2\text{H}_3\text{O}$ ; phosphate of naphthol-ether,  $\text{PO}(\text{C}_{10}\text{H}_7\text{O})_3$ ; carbonaphtholic acids;  $\alpha$  and  $\beta$  naphthol-sulpho acids—



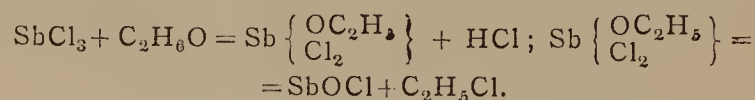
and several of its salts.

**Derivatives from Naphthaline.**—MM. Darmstädter and Wichelhaus.—A lengthy memoir divided into the following sections:—Binitro-naphthol and bichloro-naphtho-chinon from  $\alpha$  naphthol; dinitro-naphthaline; bromo-sulpho acids of naphthaline; naphtho-bioxy; bicyanide of naphthaline; bicarho-naphthalinic acid.

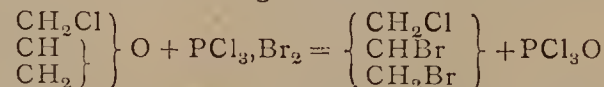
**Contribution to the Knowledge of the Constitution of the Derivatives from Naphthaline.**—M. Wichelhaus.—We reproduce the formulæ in this paper, since they are, according to the author, the formulæ expressing the constitution of the naphthols—



**Crystallised Algaroth Powder, and on Oxychloride of Antimony.**—M. Schaeffer.—When absolute alcohol and chloride of antimony are placed together in a sealed tube and heated to about  $150^\circ$ , in the proportion of 1 molecule of chloride of antimony and 3 molecules of alcohol, there is found, on opening the tube, that, while chloride of ethyl escapes, the sides of the tube are lined with a crystalline mass, which, after having been thoroughly washed with alcohol, proved to consist of chlorine and antimony, without any organic substance, the formula being  $\text{Sb}_4\text{Cl}_2\text{O}_5$ , the same which has been adopted for the *Pulvis algarothi* of the pharmacists. Another experiment, made with equal molecules of alcohol and chloride of antimony, led to the formula  $\text{SbOCl}$ ; and the reaction is represented by—



**Constitution of Epichlorhydrine.**—M. Darmstädter.—By first causing chloride of phosphorus to act upon epichlorhydrin, and next adding to the product so obtained a quantity of bromine, a fluid was obtained which, by means of fractional distillation, yielded a liquid boiling at about  $200^\circ$ ; sp. gr., at  $15^\circ$ , 2.004; formula,  $\text{C}_2\text{H}_5\text{BrCl}$ . This substance is identical with chlorhydrindibromhydrine; and the author states that the following formula—



represents the reaction, and thus proves the correctness of the view that epichlorhydrine does not contain hydroxyl.

**Preparation of Zinc Ethyl.**—M. Wichelhaus.—The gist of this paper is that it is best to apply, for the purpose of the preparation of zinc ethyl, coarsely-divided, that is to say, roughly-filed, zinc, which exhibits a great many points of contact.

**Aceto-Chlorhydrine from Octyl-Glycol.**—M. Clermont.—The author describes, at some length, the preparation and rectification of aceto-chlorhydrine by means of anhydrous acetic acid, anhydrous hypochlorous acid, and pure octylen. The aceto-chlorhydrine thus obtained is a very mobile, colourless liquid, exhibiting a pleasant aromatic odour and burning taste, insoluble in water, but soluble in alcohol, ether, and acetic acid; it is capable of burning, with a smoky greenish coloured flame; boils at  $225^\circ$ , without decomposition; sp. gr. at  $0^\circ$ , 1.026; formula,  $\text{C}_{10}\text{H}_{19}\text{ClO}_2$ ; vapour density, 7.12. On being treated with caustic potassa in a sealed tube at  $180^\circ$ , a liquid was obtained boiling at  $145^\circ$ ; formula,  $\text{C}_8\text{H}_{18}\text{O}$ —that is to say, octylen oxide.

**Uvic, Formic, Glycolic, and Glyoxylic Acids, Products of the Oxidation of Glycerine by Nitric Acid.**—M. Heintz.—A lengthy memoir wherein the author minutely describes the method applied by him for proving the four substances named to be produced when glycerine is acted upon by nitric acid.

**Contribution to the Knowledge of Sulpho-Nitrogen Acids (Schwefelstickstoffsäuren Corps Sulfazotes of Frémy).**—MM. Claus and Koch.—This paper, having also appeared in another German periodical, has already been abstracted (see CHEMICAL NEWS, vol. xx., p. 323.)

**Observations and Critical Remarks upon M. Linnemann's Paper "On the Conversion of Butyric Acid into Normal Primary Butyl Alcohol."**—M. Lieben.—This short paper is a rather sharp reply to some remarks made by M. Linnemann upon the author's researches on this subject.

*Moniteur Scientifique*, No. 314, January 15, 1870.

This number contains the following original papers relating to chemistry:—

**Bromide of Sodium.**—M. Casthelaz.—This paper treats, at length, on the different modes of the preparation of this salt—viz., by direct action of bromine and caustic soda solution; by the decomposition of bromide of iron by means of either caustic soda or its carbonate; by double decomposition of the bromide of ammonium by caustic soda or carbonate of soda. This latter method is used on the large scale

\* There is no firm in existence so largely interested in the trade and everything relating to madder, garancine, &c., as this very extensive commercial and manufacturing firm.



by the author, who describes in this paper the arrangements made by him to obtain a product free from chlorine, as well as from iodine.

**Researches on the Yama-Mai Silk.**—Dr. Bolley.—The silk alluded to is the product of a worm native of China, and feeding on oak leaves instead of on those of the mulberry tree. It appears, from this paper, that several parcels of that silk have been sent to Europe; but at Lyons, as well as at Zurich, great difficulties have been encountered in working up this silk along with, or in the same manner as the ordinary silkworm product. Several gentlemen have investigated the microscopical structure of the Yama-mai silk, and found it in almost every respect to differ from the silk hitherto generally used. The chemical composition, also, of this newly-imported substance differs: it has been found to contain, in raw state, 8.639 per cent of ash, while good raw Italian silk only contains 1.07 per cent; but, when the Yama-mai silk is first treated with some alcohol, next with dilute sulphuric acid, and then cleansed in a soap-bath, the quantity of ash is decreased to 0.59 per cent, while raw Italian silk treated in the same manner, leaves 0.95 per cent of ash. The fibroine and gummy matter of both kinds of silk have been proved identical; the colouring matter of the Yama-mai variety appears to differ from that of ordinary silk. Under perfectly identical conditions, the last-named variety of silk is more hygroscopical than the ordinary kind. Direct experiments instituted by the author have proved that the newly-imported material has a less affinity for mordants than ordinary silk, and both kinds submitted to dye-baths of the same composition and simultaneously have been proved to differ greatly as regards the colour assumed.

**On Phenyl Brown, so-called Phénicienne.**—MM. Bolley and Hummel.—This substance, also called *rothéine*, is not to be confounded with the brown colouring matter made by Messrs. Roberts, Dale, and Co., at Manchester. The phenyl brown of M. Roth's invention is a substance which, without the use of any mordant, yields, upon silk and woollen fabrics, fast colours. Since it has been alleged that the brown dye alluded to is possessed of explosive properties, the authors have investigated the manufacture and the reactions which take place during the process. The authors find that, when a mixture of nitric and sulphuric acids (1 part of the former of a sp. gr. of 1.35, and 2 of the latter, concentrated) are made to act upon phenol, two different products are always produced—one of these, a solid substance, sometimes like thick tar, sometimes grainy; and a deep red-coloured liquid. When this latter is poured into cold water, a pulverulent brown-coloured substance is precipitated, which possesses all the characteristic properties of commercial *phénicienne*. The result of the researches arrived at by the authors is that *phénicienne* is a compound mixture of binitro-phenol and a peculiar amorphous substance which has some likeness to the ulmic and humic substances, but the precise nature of which has not been ascertained.

**Action of Shellac upon some Aniline Colours.**—M. Labouret.—When a salt of rosaniline is added to a solution of any resin, that solution is red-coloured, if the salt of aniline is soluble in the solvent used to dissolve the resin; the colour has, however, a tendency to turn violet as soon as the solution is heated or evaporated to dryness. An alcoholic solution of shellac, to which fuchsine has been added, turns, on evaporation, to a most magnificent blue colour. This material is insoluble in ether, but soluble in alcohol and acetic acid, the solutions exhibiting a blue colour. The product is, however, very unstable; and the only use this reaction could be turned to is, according to the author, the detection of shellac among other resins, since a very minute quantity of the last-named resin may by this means be detected.

*Les Mondes*, January 20, 1870.

**Nickelising.**—It appears that, as the result of researches instituted by MM. Adams, Gaiffe, and Boston, a company has been formed in America (U.S.) with the view of nickelising—i.e., covering other metals, by galvano-plastic means, with a more or less thick coating of pure nickel. Since that metal is very hard, it resists, even in thin layers, rather rough usage; it is not oxidised, even in contact with water, at the ordinary temperature, and the metal assumes a brilliant polish if required. The method employed for the deposition of nickel will be fully described, since this subject was treated of at length at the meeting of the Academy of the 17th instant. The secret of the success is the use of a preparation of a very pure double sulphate of ammonia and nickel. The Company alluded to have established a branch manufactory at Paris under the management of M. Gaiffe.

**Species of the Genus Equus.**—M. Sanson.

January 27, 1870.

**Cast-Iron Stoves.**—Dr. Sacc.—The author mentions that some experiments made in his laboratory fully prove that cast-iron stoves, even if they are allowed to become red-hot, are not injurious to health, provided care be taken to ensure a proper ventilation and draught in the chimney, or, rather, in the pipe leading from the stove into it. The use of cast-iron stoves, the author says, is not injurious to health, but becomes so only with imperfect draught; and that defect impairs the good use of all kinds of stoves, no matter whether they be made of cast- or wrought-iron, or of any other material.

**Use of Hypophosphoric Acid in Agriculture for the Purpose of Destroying Noxious Insects.**—M. Martin.—The author proposes, more especially for the purpose of destroying the *Phylloxera vastatrix*, which makes great havoc in the vineyards, to apply hypophosphoric acid dissolved in water. The makers of phosphorus obtain a quantity of this acid in aqueous solution, which is thrown away as

waste; but, since the transport of this waste liquid is too costly (it may be very usefully applied where it can be had with ease), the author describes a method of making hypophosphoric acid by the slow combustion of phosphorus. According to his experiments, 2 grms. of this acid, dissolved in 10 or 12 litres of water, is a strong poison for all kinds of insects, and not only does not hurt plants, but has the effect of increasing the soluble phosphates in the soil.

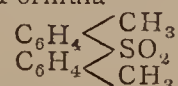
**Researches on the Improvements to be made in Galvanic Batteries.**—M. Delaurier.—A lengthy paper accompanied by several engravings.

**Thermo-Electrical Apparatus with Galena and Iron.**—MM. Mure, Clamond, and Gaiffe.—According to the results of the experiments described at length, this apparatus deserves the attention of all who require galvanic batteries, since regularity and steadiness of action are here combined with economy and the absence of inconvenient vapours.

*Zeitschrift für Chemie von Beilstein*, No. 2, 1870.

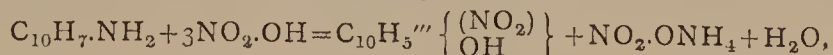
This number contains the following original papers:—

**Sulphotoluide.**—MM. Otto and Gruber.—Sulphotoluide, as obtained when its solution in benzol is slowly evaporated, is a beautiful crystalline substance, fusing at about 156°, insoluble in water, difficultly soluble in cold alcohol and ether, and readily soluble in benzol, chloroform, and sulphide of carbon; it is soluble, without decomposition, in fuming nitrous-nitric acid, and is not acted upon when heated to 160° in sealed tubes along with a concentrated solution of caustic potassa in alcohol. Formula—



**Two Isomeric Pentachlorobenzols and Bichlorobenzol-Chloride.**—M. Otto.—There exist, says the author, two isomeric pentachlorobenzols,  $\text{C}_6\text{HCl}_5$ . One of these is a needle-shaped, crystalline substance, not soluble in ether or alcohol, even when boiling, but soluble in benzol and chloroform, and melts at about 199°; the other substance of this name is readily soluble, even in cold alcohol, and its melting-point is 85°. Dichlorobenzol-chloride,  $\text{C}_6\text{H}_4\text{Cl}_2\cdot\text{Cl}_2$ , is soluble in chloroform.

**A New Mode of Formation of Binitronaphthol.**—Dr. Balló.—When naphthylamine is treated with nitric acid (sp. gr., 1.35), an energetic action takes place, and the result is the formation of binitronaphthol, according to the following formula:—



*Bulletin de la Société Chimique de Paris*, December, 1869.

This number contains the following original papers and communications:—

**Studies on the Sewage-Water of Paris.**—M. Chevalet.—From this paper, we learn that the portion of the sewage soluble in water (the solid muddy deposit is converted into a kind of dry manure) contains by far the larger quantity of valuable ammoniacal salts, and retains in suspension nitrogenised organic matter, which it is never possible to obtain precipitated; there remains, moreover, similar organic matter in solution. The quantity of soluble ammoniacal salts amounts to 3.371 kilos. to the cubic metre of sewage, and, in addition thereto, it contains 640 grms. of azotised organic matter.

**Determination of the Molecular Groups Decomposed by an Electric Current.**—M. Bourgoïn.—This paper, and the following—

**Electrolysis of the Organic Alkalies.**—M. Bourgoïn—are too lengthy to admit of any useful abstraction.

*Revue des Cours Scientifiques de la France et de l'Etranger*, Nos. 1 to 7, inclusive (from December 4, 1869, to January 8, 1870).

This collection does not contain, among the very valuable and interesting scientific matters embraced by it, any original paper on chemistry or sciences connected therewith. The last number, however, contains a very extensive review of a book, "Cours de Chimie Inorganique d'Après la Théorie Typique de Gerhardt, par A. Daxhelet, 2 vols. in 8vo. (Paris: Baudry).

**Population of Cuba.**—From this paper, we learn that the increase of the population of that island has increased to an amount second to that of the increase of the population of the United States, and, excepting the latter, more than that of any other part of the world. The present population of Cuba exceeds 2,000,000 inhabitants.

The *Revue* above named contains a great many papers of interest to medical men.

No. 8, 1870.

This number does not contain any original paper relating to chemistry or allied sciences, but we meet here with an excellent physiological paper on the—

**Effects of the Climbing of High Mountains upon the Human System.**—M. Lortet.

No. 9, 1870.

**The Astronomical Observatory at Paris.**—The staff of this institution has resigned, and the Minister of Public Instruction will



have to choose either to keep M. Le Verrier, and accept the resignation of the whole staff, or accept the resignation of the former, and appoint another director. It appears that very serious dissension has arisen among the parties, giving rise to daily scenes not seemly in a scientific establishment.

*Annalen der Physik und Chemie, von Poggendorff, No. 12, 1869.*

This number contains the following original papers:—

**Thermo-Chemical Researches.**—M. Thomsen.—The third instalment of a lengthy paper on this subject, containing the following sections:—Sulphuric acid; selenic acid; sulphurous acid; selenious acid; hyposulphuric acid.

**Mineralogical Researches.**—M. vom Rath.—The author describes, among other substances, a newly-discovered mineral from the neighbourhood of Laach (Rhenish Prussia). This mineral has been named *amblystegite*. It contains, in 100 parts:—Silica, 49.8; protoxide of iron, 25.6; magnesia, 17.7; lime, 0.15; alumina, 5.05; water, 0.5. *Meteorite from Girgenti, Island of Sicily.*—It appears that of this meteorite only very small bits have been obtained in some museums. The author accidentally got a large lump which a friend sent him from Palermo, and thus an analysis became possible, giving, in 100 parts, the following results:—Chrome iron, 1.20; sulphur, 2.24; iron, 3.43; silica, 43.41; alumina, 1.57; magnesia, 26.84; lime, 1.85; protoxide of iron, 17.96; protoxide of manganese, a trace; soda, 1.50.

**Crystallographical Description of the Salts derived from Sulpho-Acids of Phenol.**—M. vom Rath.—Purely a crystallographical monograph.

**Experiments on Dispersion Figures (Zerstreuungsbilder).**—M. Bezold.

**Vibrations of a Layer of Air corresponding to those of a Fixed Disc.**—M. Vierth.

**Reply to the Critics of M. Boltzmann.**—M. Most.

**Experimental Researches on the Effect Heat Exercises upon Electromotive Force.**—Dr. L. Bleekrode.—A lengthy monograph of great merit on a subject first investigated by Faraday.

**New Sulphur Salts (Third Paper).**—M. Schneider.—The author describes:—Potassiumplatinum-sulphoplatinate, obtained by fusing together 2 parts of spongy platinum, 6 of pure carbonate of potassa, and 6 of sulphur. After cooling, the mass is treated with water; what remains undissolved, exhibiting a crystalline appearance and reddish lead colour, accompanied by metallic lustre, is the salt alluded to—



Sodiumplatinum-sulphoplatinate—



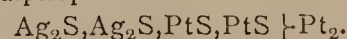
Potassiumplatinum-sulphostannate—



Sodiumplatin-sulphostannate. Disodiumplatinum-sulphoplatinate—



Argentumplatinum-sulphoplatinate—



Thalliumplatinum-sulphoplatinate; this salt, obtained by a rather complex process, is insoluble in cold water; dilute hydrochloric acid extracts all the thallium, without the least evolution of sulphuretted hydrogen; formula—



**Researches on Mica Combinations.**—M. Rensch.—A purely mineralogical paper.

## MEETINGS FOR THE WEEK.

MONDAY, Feb. 7th.—Royal Institution, 2. General Monthly Meeting. Medical, 8.

London Institution, 4.

TUESDAY, 8th.—Royal Institution, 3. Professor Humphry, "On the Architecture of the Human Body."

Institution of Civil Engineers, 8.

Photographic, 8. Anniversary.

Ethnological, 8.

WEDNESDAY, 9th.—Society of Arts, 8.

Geological, 8.

Microscopical, 8. Anniversary.

THURSDAY, 10th.—Royal Institution, 3. Prof. Odling, "On Chemistry."

London Institution, 7.30.

Royal, 8.30.

Zoological, 8.30.

Royal Society Club, 6.

FRIDAY, 11th.—Royal Institution, 8. Dr. Carpenter, "On Temperature and Life in Deep-Sea."

Astronomical, 3. Anniversary.

Quekett Club, 8.

SATURDAY, 12th.—Royal Institution, 3. Mr. Scott, "On Meteorology."

## NOTES AND QUERIES.

**Egg and Blood Albumen.**—Can any of your readers inform me of a good method of testing the value of egg and blood albumen.—W. B.

**Production of Ozone.**—Would you kindly inform me, through the medium of your valuable journal, the cheapest and best mode of producing ozone in quantity, and if a process described in the *Daily Telegraph* some months since is practicable, and if protected by a patent?—X. Y. Z.

## TO CORRESPONDENTS.

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## BOOKS RECEIVED.

The Manchester Examiner and Times, Jan. 29, 1870, containing a letter by Dr. Bedford on "The Flames upon the Sun."

On the Combining Power of Chemical Elements, by Prof. S. D. Tillman. New York.

The Medical and Surgical Reporter.

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London: Longmans, Green, and Co., Paternoster Row.

Just published, demy 8vo., price 6d.

**On English and Foreign Alkalimetric and Chlorimetric Degrees**, by John Pattinson, F.C.S. Read before the Newcastle Chemical Society.

London: CHEMICAL NEWS Office, Boy Court, Ludgate Hill, E.C.

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# THE CHEMICAL NEWS.

VOL. XXI. No. 533.

## NOTES FROM THE LABORATORY OF A SUGAR REFINERY.

By WILLIAM ARNOT, F.C.S.

(Continued from p. 50.)

### IX. CHAR TREATMENT.

WHEN a refiner discovers his char stock to be in a "diseased" condition, he naturally begins to look about for some method of treatment, by the adoption of which the quality of his char may be improved. The search is usually made in a hap-hazard way; no very definite notion of what the disease really is which affects his char having been obtained, a process for the removal of iron or lime may be adopted when the real source of the inefficiency of the char may be excess or deficiency of carbon, or such like. The first step which ought to be taken when a char ceases to give satisfactory results is to have it carefully analysed; but this will be of comparatively little use if analyses have not been formerly made. A regular monthly or bi-monthly analysis of every refining stock should be made, and the results of each compared with those preceding; the refiner will thus be able to trace the nature and progress of disease in his char, if any exists. If suspicion is thus aroused that all is not right, more frequent analyses should be made, and, at the same time, some well-considered system of treatment adopted. It may be well to draw attention here to the obvious necessity for such analyses being made with rigorous care. An increase or decrease of carbon from week to week or from month to month of 0.5 per cent, increase or reduction of calcic carbonate to the same extent, or an increase of iron to the extent of 0.1 per cent of oxide, are most important indications, and ought to receive the special attention of both analyst and refiner.

A fair idea of the nature of the defect having been obtained, the mode of treatment most likely to improve the char must be carefully considered. It will very frequently be found that the safest, most efficient, and, in the end, least expensive course to follow will be to increase the washing; to use the washing water boiling, instead of simply "warm"; to see to the kilns and coolers being tight, and the working of them specially attended to; to reject suspicious sugars; and generally to give greater attention to the employment of careful and efficient workmen. The writer has more faith in measures such as these, than in the hasty adoption of special systems of treatment, which often lead to mischievous results. But, in the face of every precaution, "diseases" do creep in sometimes, and the adoption of some special measures may be imperative; but, whatever the system to be adopted, numerous and frequent, carefully-conducted, small-scale experiments should first be made. The diseases open to special treatment are, as indicated in the preceding note, principally excess of lime and iron. For the removal of these, the following processes have been adopted with more or less success.

1. *Fermentation* of various kinds and degrees. The char may be left in the cisterns with a little "sweet" remaining in it (*i.e.*, without being thoroughly washed) for some days, during which time a brisk action will take place: the traces of sugar, as well as the several organic impurities left in the char, are decomposed, with forma-

tions of various weak acids, which combine with the lime, forming salts easily removable by washing. Or a quantity of "sour water" may be run upon the char, and allowed to stand as before; the action will be the same, slightly intensified. Many modifications of this system are in use, the action in all cases being the same in kind, differing only in degree. Crude acetic acid and churned milk have also been used to promote and intensify acetic and lactic fermentations.

Fermentation is a simple and cheap mode of treatment, but the results, although generally in the right direction, are not usually very great. The amount of acid produced is comparatively trifling, and has seldom any action upon the iron, enough lime being generally present to saturate the acid as produced. It has its harmlessness to recommend it; but it keeps the char an objectionably long time out of use, and, moreover, monopolises the char cisterns to a serious extent. This latter objection may be got over by adopting a system of "dry fermentation," in which the char, well drained, but moist, and containing the fermenting agents already referred to, is removed from the cisterns, and allowed to lie in a heap for a week or two, or until all action has ceased. This process, however, involves a large amount of additional labour, and, as in the other case, keeps the char out of use longer than desirable.

2. *Dilute Hydric Chloride* has been used, in various ways and in all degrees of strength; and, for the removal of iron, perhaps no better agent can be employed. Sodic sulphite has been recommended to be used, along with hydric chloride, for the removal of iron; but the writer has not found the results of such treatment at all satisfactory. Hydric chloride must at all times be used with extreme caution; very dilute solutions should always be preferred, though the amount of lime or iron removed should be the smaller. The effects of any acid treatment is never perfectly satisfactory: the amount of impurity removed is generally less than anticipated; danger of injuring the structure of the char always exists; in whatever way the acid is applied, some of the char is certain to get more than its share, another portion getting less; while the entire removal of the acid from the char, after it has done its work, is difficult, if not impossible. Char, after having been treated with acid, washed, and re-burned, always shows an acid reaction—so difficult is the acid to wash out; and this residual acid has the effect of misleading the refiner when his sugar-liquor passes through the char for the first time. The liquor will look unusually bright, and light in colour; but colour due to the presence of traces of acid is valueless, as, in the process of boiling, it entirely disappears. Dr. Wallace, in his lecture to the Chemical Society, indicates that the colour of the sugar produced in such circumstances is superior, though the syrups are increased in quantity. This the author has not found to be the case; the syrups are increased, but the colour of the sugar is not improved.

3. *Gaseous Hydric Chloride*.—Mr. Beanes's process has already been referred to (Note VIII.) When the circumstances which obtain are such as to warrant its use, great care must be taken to have apparatus of the best construction, and thoroughly trained workmen to attend to the various operations involved. When the excess of lime has been removed, the process will, of course, be stopped until, by a sufficient increase of that impurity, it can again be used with safety and with profit. Dry gaseous hydric chloride has no action upon the iron; so that, for the removal of that powerfully-injurious agent, it is inapplicable.

Various other acids have been used with a view to improve the quality of animal charcoal, but (unless in very special cases) with very discouraging results. Even carbonic acid has been used, forced into the char in the gaseous form under high pressure, under the impression that the calcic carbonate would be changed into bicarbonate, and thus rendered soluble. This may serve as an



illustration of a rather numerous class of "inventions," the results of which are not only valueless, but, in some cases, most injurious. A case has come under the writer's notice, almost too absurd to be mentioned, in which undilute oil of vitriol was poured direct from the carboys upon the char in the cisterns. After the mixture had been allowed to act *a sufficient length of time*, it was dug out in blocks with picks! This process was conducted under chemical supervision!

The preservation of char in a state of efficiency is perhaps the most important problem in the sugar-refining industry; and certainly it were much better for the refiner to devote his best energies to the retention of his char in good condition, than to be compelled to adopt expensive, troublesome, and often questionable processes, with a view to restore qualities which, through careless working, have been lost. The question of char treatment is a most troublesome one; and, although almost every likely process has been practically tried, both on the large and small scale, by the author, the results have never given him unalloyed satisfaction. He is, therefore, the more desirous of impressing upon refiners the desirability of caring well for good char when they have got it.

A favourite "cure" for faulty char with some, is to mix in new or faultless char in various proportions; but, as must be self-evident to anyone who will carefully look at the subject, this is only to disguise the weakness of the old by the potency of the new. A char having a higher average quality will doubtless be the result of such admixture; but it is a mistake to suppose that the faulty char will thus be cured.

St. Anne's Laboratory, Lasswade, N.B.,  
January, 1870.

## ON MICROSCOPICAL MANIPULATION.\*

By W. T. SUFFOLK, F.R.M.S.

(Continued from p. 52).

A VERY ingenious printing process, known as *graphotype*, has been lately brought forward. In this, a quantity of finely-powdered chalk is compressed into a solid tablet; this is drawn upon with a fine brush charged with an ink which hardens the chalk wherever it touches. The drawing is then sent to the patentees, who brush away the chalk, leaving the lines standing. A mould is made in plaster of Paris, from which a cast in type-metal, capable of yielding impressions in the common printing-press, is taken. Every facility is afforded by the Graphotyping Company, No. 7, Garrick Street, W.C., to persons wishing to test the merits of the process.

*Lithography* printing remarkably from all the processes of multiplying impressions just described. While, in plate and surface printing, it was essential that there should be a difference of level between the parts intended to print light and dark, in the various lithographic processes, light and dark are all printed from the same surface. The operation is purely a chemical one, and depends upon the mutual repulsion of oil and water. The stone used is a fine-grained and very compact limestone, capable of bearing a high polish, principally supplied from quarries at Solenhofen; and it would seem that it was destined to transmit natural history information to posterity, as many of the slabs enclose fossil-insects, as perfectly preserved as if they had been shut up between the leaves

of a book for a few weeks, instead of ages. The British Museum has a very large collection of these specimens of Nature's lithographs. If a grease-mark be made upon the smooth surface of this or similar stone, and it then be wetted, it will be found, upon passing a roller charged with printing-ink over the stone, that the ink will adhere to the greasy portions, while it will be repelled by the parts that are wet. If the stone, with a sheet of paper on it, be passed under the press, an impression will be obtained; and, by a series of wettings and inkings, the operation may be repeated any number of times. This is the foundation of all the lithographic processes, which are numerous, and suited to the production of a great variety of effects, mostly by the use of means differing less from the ordinary manipulations of the artist than any of the other means of multiplying drawings. The use of grease or oil as a material for drawing upon stone is open to many practical objections; therefore, a greasy material is manufactured, more closely resembling, in form, that used in the ordinary process of drawing. It is composed of a mixture of tallow, soap, wax, and shellac, with a portion of lamp-black, to give it sufficient colour to guide the artist in making his drawing. The proportions vary according to the purpose for which it is required, and the combination of the materials is a matter of very nice manipulation. It can be procured, properly prepared, of the dealers in lithographic materials, and will be found in the form of crayons of three degrees of hardness, which are used like ordinary artists' chalks, and cakes, which are soluble in water, and can be rubbed down like Indian-ink, care being taken to use distilled or very pure water, otherwise, from the soapy nature of the ink, it will not mix freely.

In making drawings with the ink, a fine brush or suitable steel pen may be used; and, if the drawing is to consist entirely of ink-work, a polished stone should be employed. Care should be taken not to touch the stone with the fingers, as every greasy mark, although invisible when made, will print when the stone is rolled in. If the crayons, or chalk, are used, the stone should be what is called "grained," that is, its surface should be prepared with a texture somewhat like that of drawing-paper, to enable the chalk to be rubbed off the crayon and held by the stone. The fineness or coarseness of the grain must be suited to the nature of the drawing: microscopical drawings usually require a very fine grain. The manipulation is somewhat like that of pencil and chalk drawing on paper, only taking certain precautions rendered necessary by the nature of the material. All light tints should appear darker on the stone than they are intended to print, as they lose some of their strength in the preparation which the stone undergoes before it is printed from. Dark tints should be worked up gradually, by repeating the touch of the chalk in as many directions as possible, so that the minute papillæ, or roughnesses, which form the grain of the stone may be loaded with the chalk on all sides, and consequently suffer less in the etching process. Any attempt to produce a dark tint or spot by a vigorous and sudden touch, as in pencil drawing, will generally fail when the stone is printed. Ink outline may often be used with great advantage in combination with chalk shading. In this case, the outline should be put on the stone with the ink first, and the shading done afterwards, as it is difficult to see the ink outline

\* The substance of a course of lectures delivered to the members of the Quekett Microscopical Club, January—April, 1869.



when the stone is covered with shading, and the chalk is also likely to hinder the adhesion of the ink to the stone. Care should be taken that the work is perfect before it is sent to the printer, as but little or no alteration can be made after the proof is taken. This is one of the greatest defects of lithography, and is unlike copper-plate, where the artist goes on improving and re-touching, after a series of proofs, until perfection is attained. When the printer receives the stone, he washes it with very dilute nitric acid, which converts the soapy ink into grease, and prevents its being washed off in subsequent processes. The stone is then covered with gum-water, which adheres to the parts not touched with ink, and prepares the stone to receive the wet. Then, by a series of spongings with water and rollings with printing-ink, the stone is made ready to yield a very large number of impressions. With a little perseverance and the assistance so kindly afforded by most lithographic printers,\* any person who can draw may hope, after a time, to re-produce his works upon stone with tolerable success.

Another process, capable of producing very delicate results, and well suited for microscopical purposes, is that known as engraving on stone. It is by this mode that most of the beautiful works of Mr. Tuffen West are executed. It consists in scratching the lines and dots forming the picture with a diamond-point on a highly polished stone, of which the surface has been slightly coloured, to render the marks visible. Care should be taken not to cut deeply, but only slightly to scratch the stone. The printer rubs the engraved stone with grease, which adheres to the scratches, which, when the stone is rolled in, print as black lines. This process requires much more practice than either chalk or ink drawing; but its results, when well executed, almost rival fine steel-engraving.

White-line lithography, on a black ground, is useful for representing many tissues. It is executed on a polished stone, which is prepared by the surface being covered either with a coat of lithographic ink or grease and lamp-black. The artist, with a diamond-point, cuts through the black ground, taking care to lay bare and slightly incise the stone. The diamond is a very free-working tool, and obeys the hand beautifully after a little practice. This process is remarkably easy and expeditious, and is worthy of having its powers developed. Very little use has been made of it at present. It seems capable of great delicacy; and, as so many microscopical observations are made on a black ground, either with the parabola or by reflected light, this process seems to be one very well suited to the wants of the microscopist. As a compensation for the ease of execution, it would seem that black-ground lithographs entail some trouble on the printer, as the fine lines are apt to fill up; but as this kind of printing becomes more frequent in use, doubtless the difficulty will be thought much less of. The author strongly recommends microscopists who have drawings to publish, and who cannot afford the cost of professional assistance, to master some one or other of the lithographic processes. Their work will doubtless, even after some practice, be rough, and not equal to the productions of experienced lithographic artists; but it will have an advantage which

is possessed by no copy of a drawing, however good: it will be an autograph, re-producing all the author's peculiarities of style, and preserving those points which are very often lost in the copying of drawings by those who are not familiar with the subjects represented.

The student who wishes to render the microscope really valuable to him must determine, after mastering the technical difficulties of his instrument, to apply himself diligently to the study of some particular subject. One of our greatest authorities (Dr. Carpenter) speaks of "microscope power running to waste" in this country. Another author says:—"We have the best microscopes in the world, and the fewest observations." And it is to be feared that there is much truth in these statements. The microscope is, in the hands of many persons, only a costly toy. It should be regarded rather as a tool, and the naturalist's most efficient one. The work of the microscope does not consist in resolving the striæ of difficult diatoms; this has been done over and over again, and yet we seem to be not much nearer the truth than before. However, if we cannot understand the markings of the diatoms, they have done us service: they have caused our instruments to be continually improved, till now it is doubtful whether much more advance can be made.

The beginner is strongly recommended to go carefully through the tables at the end of Dr. Beale's "How to Work with the Microscope," carrying out the principles there laid down; for, though the work is principally written for students of anatomy and physiology, it may be consulted by all enquirers with great benefit. Great progress may always be made if the student has the good fortune to be acquainted with some working microscopist. Many such are glad of the assistance of others; and, although the beginner may not be able to originate an enquiry, he may confirm and verify the observations of others, and, in so doing, add largely to his own stock of knowledge.

The numerous microscopical societies in London and elsewhere offer great facilities to the young student, by giving him opportunities of becoming acquainted with the best practical microscopists. Many of the societies have regularly organised collecting-excursions, under the direction of experienced persons. By attending these meetings much information may be gained.

The recent application of the spectroscope to microscopical research will no doubt be a very promising field of enquiry. Already, besides other discoveries, the distinction between two vegetable reds (those of the grape and elder-berry) has been pointed out by its means, and will probably lead to the detection of methods of adulteration which have hitherto baffled both chemists and microscopists; and many more very important results may be expected to be elicited by steady application and careful use of this most delicate means of distinguishing colour. The use of the microscope is far from being confined to those sciences which are connected with natural history. The instrument has been applied, with the greatest advantage, to researches on inorganic matter; and much valuable information has been obtained by the observations of Mr. Sorby and others who have devoted themselves to such enquiries.

\* The author has been much indebted to the artists in the office of Mr. West, Hatton Garden, for much valuable information.



## ON ORGANIC MATTER IN THE AIR.\*

By Dr. R. ANGUS SMITH, F.R.S., &amp;c.

I HAVE worked and written so constantly on impurities in air and water that last year I was told by a periodical of high position that I was quite regardless of the impression made on timid persons, and I began to compare myself to a collector of "varieties," who is often obliged to bring up his curiosities every five years. When I read of the new experiment by Professor Tyndall, showing to the naked eye the numberless bodies in the air, I was abundantly gratified, as I obtain them only by a laborious although simple process. When, however, Dr. Tyndall began to show the character of these bodies, it "smote the chord of self," as I imagined that I had long ago proved that not only organic and inorganic, but organised, forms exist in the atmosphere. Neither do I claim this as my original idea, looking rather to the fulness of proof and quantitative results as mine. I think, therefore, I may remind my friends of some of my work, as I find that they forget; and even I forget the exact words used by myself, and must read up.

But, as people do not read much on a subject, I will begin at the end. I have been for two years attempting to measure the amount of putrescible matter in the air of the towns and country-places; and I have succeeded to a considerable extent. I also measure the amount that has putrefied and left its remains in the air—the sewage of the atmosphere. Some of my results are published. I have promised some very soon, and some have been ready for printing, under the head of "Chemical Climatology." The proof of organic matter is old. I seek the quantity in various towns and parts of towns.

I shall not here give a history of the enquiries. So many people claim to have something to say in the matter, that I might amuse myself, if not the public, by a long account. At present, I profess to keep almost entirely to my own work. The knowledge of organic matter in the air has never been absent entirely from men's minds in historic times; but the words of Bishop Berkeley are so clear that I prefer to quote them; besides, he is far enough back for the purpose. He says, in "Siris" (par. 140):—

"Nothing ferments, vegetates, or putrefies without air, which operates with all the virtues of the bodies included in it—that is, of all nature. . . . The air, therefore, is an active mass of numberless different principles—the general sources of corruption and generation; on the one hand, dividing, abrading, and carrying off the particles of bodies, that is, corrupting or dissolving them; on the other, producing new ones into being, destroying and bestowing forms without intermission."

And, in paragraph 141, he says:—

"The seeds of things seem to be latent in the air, ready to pair, and produce their kind whenever they light on a proper matrix. The extremely small seeds of ferns, mosses, mushrooms, and some other plants, are concealed and wafted about in the air, every part whereof seems replete with seeds of one kind or other. The whole atmosphere seems alive. There is everywhere acid to corrode and seed to engender. Iron will rust, and mould will grow in all places."

No man has, before or after him, expressed this truth more completely and beautifully. It is hard to improve it by one word. Still, this age demands more detailed knowledge and exact theory. Besides, the work of every few years requires to be done again, to suit modern methods, although it must be confessed that there is room for the cynic to say that Bishop Berkeley and all the ancients and moderns might be classed with Topsy, who think they have explained all by saying—"It grows."

I began to examine the air in 1846, and I brought a short notice before the Chemical Society: a simple mode

of obtaining organic matter in the condensed breath on windows is recorded in their transactions. On account of this commencement, which promised favourably, the British Association requested me to report on the subject. My report, published in 1848, was considered to have made advance, and was marked out for special mention by the President of the succeeding year, so that the words were not hidden. I quote a part, "That animals constantly give out a quantity of solid organic matter from the lungs, may readily be proved by breathing through a tube into a bottle, when the liquid or condensed breath will be collected at the bottom of the bottle; or by breathing through a tube into water, when a solution of the same substance will be found in the water. This would scarcely require proof if we consider that breath so frequently has an organic smell."

"If this condensed breath be put on a piece of platinum, or on a piece of white porcelain and burnt, the charcoal which remains and the smell of organic matter will be conclusive. If it be allowed to stand for a few days (about a week is enough), it will then show itself more decidedly by becoming the abode of small animals. These are rather to be styled animalculæ, and very small ones certainly, unless a considerable quantity of liquid be obtained; they may be seen with a good microscope. Animalculæ are now generally believed to come from the atmosphere and to deposit themselves on convenient feeding places; that is, they only appear where there is food or materials for their growth, and they prove of course the existence of that continuation of elements necessary for organic life. At the same time their presence is a proof of decomposing matter, as their production is one of the various ways in which organised structure may be broken up."

"I mentioned some time ago that I had got a quantity of organic matter from the windows of a crowded room, and I have since frequently repeated the experiment. This matter condenses on the glass and walls in cold weather, and may be taken up by means of a pipette. If allowed to stand some time it forms a thick, apparently glutinous mass; but when this is examined by a microscope, it is seen to be a closely matted confervoid growth; or, in other words, the organic matter is converted into confervæ, as it probably would have been converted into any kind of vegetation that happened to take root. Between the stalks of these confervæ are to be seen a number of greenish globules constantly moving about, various species of Volvox, accompanied also by monads many times smaller. When this happens the scene is certainly lively and the sight beautiful, but before this occurs the odour of perspiration may be distinctly perceived, especially if the vessel containing the liquid be placed in boiling water.

"If air be passed through water a certain amount of this material is obtained, but I have found it difficult to pass a sufficient quantity through. If it is made to pass rapidly, *absorption does not take place*, and evaporation of the water is the consequence; if it passes slowly, it requires several weeks to pass a 100 cubic feet through a small quantity of water. I continued the experiment for three months, but although I obtained sulphuric acid, chlorine, and a substance resembling impure albumen, I did not get enough to make a complete examination; and indeed this could not be expected, as I found that in that time less than 1000 gallons of air had passed through.

"When this exhalation from animals is condensed on a cold body, it, in course of time, dries up, and leaves a somewhat gelatinous organic plaster. We often see a substance of this nature on the furniture of dirty houses, and, in this case, there is always a disagreeable smell perceptible."—*Mems. Brit. Association Meeting, held in August, 1848.*

I quote the words used by the President of the Association simply to show that the paper was well known:—

"For instance, the causes which, in our great cities, hasten the death and debase and embitter the life of so

\* Read before the Manchester Literary and Philosophical Society, Jan. 25th, 1870.



many have at last been forced by chemists and physiologists on the notice of the public. Look at Dr. Smith's report on the air and water of towns in this volume; and, when we think that the victims of the deadly influences which are there revealed are chiefly found among the people whose industry is the foundation of our greatness,—that every year cut off from the life of each of these is so much subtracted from national wealth,—even were all moral sense and religious feeling dead in us, we must confess that the knowledge which is capable of averting them 'is of use.'

Looking over these words at this distance of time, it seems to me scarcely possible to write more clearly, although some of the words I should prefer to see changed. Still, the subject was a continued study, and it was my strong desire to measure exactly the amount of organic matter. Not to detail all the attempts, I may come to the report to the Cattle Plague Commission in 1866, in which I give some general views and allude to the works of others. The following may be quoted:—

"It has often been asked—Will a sewer produce cholera, or plague, or cattle disease? We cannot say so, or that every kind of disease may be produced from such accumulations of organic matter. The great epidemics that have passed over Europe seem always to have come from some extraneous source, to act *as if planted by some seed*, and not to have risen up spontaneously here. Without attempting to examine this matter carefully, the result would seem to be that, whilst the decomposition of organised beings after death produces gases and vapours that are opposed to health, these gases or vapours are incapable of originating, although they may be capable of feeding, some of those diseases, such as cholera or plague, which have been observed at all times to come from a warmer climate. There must, however, be some first origin of these diseases; and we cannot prove that the first origin might not take place in our climate, although it seems probable that it requires a warmer sun and a richer vegetation than is to be found in the north. This, however, is sufficiently made out—that, when these diseases do come amongst us, they take root with most effect in those places where decomposing matter is found. If we were to suppose a seed of disease planted in a rich, fertile soil of decomposing matter, we should give a pretty fair description of the fostering effect of impurity on disease. It would, in fact, appear as if the putrid matter itself took the disease, and transferred it to the living. There seems to be nothing entirely opposed to this view of the case. The question, however, is, and has always been—What is the nature of that substance which may be said to form the seed, or germ, of the disease? Chemists have been inclined to consider it a substance in process of decay, as the quotation from Liebig already given shows. Physiologists and microscopists have been more inclined to consider it as an organised substance. When Gay Lussac passed a bubble of air into the juice of grapes, and found that fermentation began at once, it was believed that the oxygen was the prime mover, and that when once begun, the action did not cease. When, however, Dusch and Schroeder found that flesh did not decompose if the air was previously passed through a good filter of cotton wool, some difficulty was thrown on the subject. It would appear as if oxygen were not the only agent in the atmosphere causing decomposition. The investigations of M. Pasteur, who found the subject in this uncertain condition, have advanced it so far that we may now with certainty reason in the belief that organised substances are really found in great abundance in the atmosphere (in all places), and that they are the cause of some hitherto entirely mysterious phenomena, putrefaction included. His object was first to inquire into the possibility of spontaneous generation, and he found that carefully filtered air allowed no organisms to appear in vegetable solutions. He found that near the usual surface of the ground these organisms were so numerous that whenever a vessel containing vegetable matter fit for their growth was opened for a very short time they were found

to enter, that in cellars and damp and quiet places, where there was no air or dust floating about, these organisms were fewer, and that, as he ascended the sides of the Alps and the Jura, they diminished in number. A commission of the French Academy confirmed his results. If we examine previous enquiries into the compounds resulting from the decomposition of organic substances, we shall find nothing which is at all calculated to bring out such an intelligible rational view of the origin of many diseases, and also of some phases of putrefaction. Chemists, when they have examined products of the latter action have found sulphuretted hydrogen, carburetted hydrogen, hydrogen, carbonic acid, nitrogen, hydrogen, ammonia, acetic acid, lactic acid, butyric acid, and numerous uncertain bodies having no activity, and utterly incapable of producing those prodigious results that are found when that force begins to work which produces plague, small-pox, or black death."

I did not enter on Pasteur's ground,—the action of organisms in producing fermentation.

(To be continued.)

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## PROCEEDINGS OF SOCIETIES.

### CHEMICAL SOCIETY.

February 3rd, 1870.

Dr. A. W. WILLIAMSON, F.R.S., &c., President, in the Chair.

MR. CHAPMAN read "*A Note on the Organic Matter Contained in the Air.*"

Some time ago, the author, in connection with Mr. Wanklyn and Mr. Smith, found that the smallest traces of nitrogenous organic matter in water could be detected by converting the nitrogen of the organic matter into ammonia, and then trying with Nessler's test. It occurred to the experimenters that the process might be extended to the investigation of the air, by washing it with water, and examining the water; but Mr. Chapman found the operation of washing the air more difficult than he had expected. It seemed the most obvious method to draw air through water, or through some other medium which would have afterwards to be washed with water. The absorption by water alone proved insufficient. Filters of cotton-wool and gun-cotton acted very well; but neither of the two materials could be obtained free from traces of nitrogenous substances. Asbestos seemed to be sufficiently good; but the preparatory treatment it has to undergo before its use in the experiment is too troublesome. Lastly, finely-powdered pumice-stone was tried as a filtering medium, and was found satisfactory in all respects. It has to be heated to redness before it is employed, and is then moistened with some water, spread over coarser pieces of pumice, which rest on some wire-gauze fitted into a funnel. When a sufficient quantity of air (say 100 litres) has been drawn through the apparatus, the pumice is transferred to a retort which contains water freed from ammonia and organic matters; and the operation is now proceeded with exactly as if it were an estimation of nitrogenous organic matter in a sample of water.

By this method, Mr. Chapman found that the air of crowded rooms contains suspended nitrogenous organic matter, as well as volatile organic bases. The first can be removed by filtration through cotton-wool; the latter pass through the filter, and, when conducted into water, can be detected there. Air collected from the neighbourhood of a sewer contained notable quantities of these volatile bases. The author thinks it would be of interest to investigate, by the above-described method, the air in hospitals, fever-wards, and the like places.



With respect to the examination of the volatile bases occurring in the air—

Dr. MILLS suggested that the charcoal out of the Stenhouse air-filter might furnish a good means for collecting those bases.

In another paper, Mr. CHAPMAN communicated "*Some New Reactions of Alcohols.*"

Amylic alcohol, as commonly obtained, consists of two liquids, one rotating a ray of polarised light, the other not. The two may be separated by distilling the mixture from soda, calcic chloride, &c. The non-rotating alcohol is retained; the rotating distils over. But, by repeated distillations, it was found that the rotating alcohol is converted into the non-rotating by the very treatment employed to separate the two. No difference in the physical properties of the two alcohols is perceptible. The compounds of the non-rotating liquid do not turn the ray of polarised light; those of the rotating do, and that in an opposite direction to the original alcohol. These facts seem to indicate that the internal structure of organic compounds is not so permanent as we are in the habit of thinking. Another observation Mr. Chapman made whilst pursuing these experiments was that caustic soda is not merely unable to dry alcohol, but that it actually hydrates it. On proper investigation, it turned out that the sodium replaces the hydrogen of the alcohol, whilst the displaced hydrogen takes the place of the sodium in the caustic soda, and thus produces water.

The PRESIDENT, referring to this latter observation, remarked that it confirmed the idea of a double decomposition taking place when potassic hydrate is dissolved in alcohol—an idea derived from the well-known reaction of carbonic acid on a solution of potassic hydrate in alcohol, whereby ethyl-potassic carbonate, as well as potassic carbonate is formed.

Mr. PERKIN exhibited a modification of Berthelot's method for the synthesis of hydric cyanide by direct union of acetylene and nitrogen under the influence of the electric spark. Mr. Perkin takes advantage of the fact that nearly all the hydrocarbons yield, when submitted in the state of vapour to the action of the spark, more or less acetylene. Nitrogen was caused to bubble through benzole; then to pass through a globe, in which the spark was discharged; and thence into a solution of silver. After a few seconds, abundant evidence of the formation of hydric cyanide was obtained. Hydric cyanide was also produced when the spark was discharged through a mixture of ammonia gas and ether vapour. If, however, nitrogen, instead of ammonia, is employed, no cyanide is produced, notwithstanding that acetylene is formed from the ether. Mr. Perkin's modification of Berthelot's method is well adapted for purposes of lecture-demonstration.

#### MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, January 11, 1870.

E. P. JOULE, LL.D., F.R.S., President in the Chair.

"On the so-called Molecular Movements of Microscopic Particles," by Professor W. STANLEY JEVONS, M.A.

Robert Brown, the celebrated botanist, first pointed out, in the year 1827, that minute particles of unorganised matter suspended in water exhibit movements which may easily be mistaken, and were formerly mistaken, for the movements of living animalculæ. This motion is exhibited more or less by all substances which are reduced to a sufficiently fine state of division (1-5000th inch in linear magnitude to 1-50000th), and the phenomenon is familiar to all occupied in microscopic observation. Vague suggestions have been often put forth that the motion is due to heat, to electricity, or to chemical affinity, but I have been able to find few published ex-

periments on the subject, and those not of a conclusive kind.

In investigating this phenomenon, I did not learn much by varying the solid suspended substance. The silicates, indeed, appeared to be generally the most active substances, and the purest quartz crystal when reduced to fine powder oscillated rapidly; but such different substances as charcoal, red phosphorus, antimony, and sulphur were also very active. I cannot affirm that any substance is free from movement, but the metallic oxides, and the earthy salts such as carbonate of lime, appeared to me somewhat less active in comparison.

In varying the liquid, however, by dissolving different salts therein, I was soon struck by the fact that the purest distilled water alone gave the movement in the highest perfection. With a few exceptions, soon to be noticed, all acids, alkalies, or salts tended to diminish the movement in a manner wholly independent to their peculiar chemical qualities.

The inquiry was much facilitated by discovering that the microscopic movement is closely connected with the suspension of fine powder in water.\* Clay and pounded glass which are most active in the microscope are also capable of remaining long in suspension. All acids, alkalies, or salts which checked the motion under the microscope were found also to have a power which has not been sufficiently noticed, of precipitating suspended matter. At the same time gum arabic, which possesses a most extraordinary power of exciting the molecular movement, is also capable of maintaining powder in suspension, and has long been used for this purpose in the manufacture of ink. The molecular motion does not directly affect the gravity of the particles, but it prevents the particles from aggregating together into larger bodies and thus overcoming the resistance of the liquid.

That the motion is due to electricity I was soon convinced, by the close analogy with the circumstances in which electricity is produced by the hydro-electric machine. Armstrong and Faraday found that pure water in this machine alone produced much electricity, and that almost any salt, acid, or alkali prevented the action by rendering the water a conductor. Ammonia, however, is a remarkable exception, because it does not render water a good conductor, and does not prevent the hydro-electric machine from giving off electricity. In trying ammonia as an *experimentum crucis*, I found that it did not stop the microscopic movement, and had almost an inappreciable effect in precipitating suspended matter. A solution of 10 per cent of ammonia would have less effect than 1-100th per cent of sulphuric acid. The proof is rendered practically certain by the fact that boracic acid, which was also ascertained to be a non-conductor by Faraday, does not precipitate matter from suspension.

It is right to add, however, that in the case of acetic acid there is a discrepancy; Faraday stated that it does not render water a conductor; but I find that, in common with the other vegetable acids which I have tried, it occasions precipitation. The conducting qualities of the substance have not been determined with sufficient accuracy to render a mistake impossible.

It is probable that silicic acid does not render water a conductor, as I find that silicate of soda tends to increase rather than diminish microscopic movement, and is another remarkable exception to the general precipitating power of soluble substances.

I entertain no doubt that microscopic movement is closely connected with the phenomena of osmose so fully investigated by the late Mr. Graham. The connection is that of action and reaction; for if a liquid is capable of impelling a particle in a given direction, the particle, if fixed, is capable of impelling the liquid in an opposite direction by an equal force. The earthenware jars used by Graham in many of his experiments are composed of a substance highly active

\* I have since found that the microscopist Dujardin noticed this connection. See "*Manuel Complet de l'Observateur au Microscope.*" Paris, 1843, p. 60.



under the microscope, and the fact that osmose is most shown by very dilute solutions (1 per cent or less) is entirely in accordance with the electric origin of the phenomenon.

I consider it to be established experimentally that the microscopic movement is due to electric action, and if I may venture to suggest a somewhat speculative explanation of the action I would point to the experiments of M. Wiedemann on electric osmose. It was first observed by Mr. Porret that when the poles of a battery are placed in two portions of water separated by a porous division, not only is some of the water decomposed, but another and far larger portion is impelled towards the negative pole. M. Wiedemann, having exactly investigated the phenomenon, found that, for one part of water decomposed, 5,000 parts were transported through the porous septum. This impulsion is greater as the resistance of the liquid is greater, and ceases altogether when sufficient acid or salt is added to render it a good conductor. Every particle which is thrown into a polar condition by the action of water must be capable in a minute degree of exerting a similar force. In ordinary osmose the particles being fixed cause a transportation of the fluid; in microscopic movement, on the other hand, the particle is free to move, and the reaction of the liquid probably produces those movements which are visible in the microscope.

Although I have chiefly confined my attention to inorganic substances, I have also found that all organic solid particles which are sufficiently small exhibit the movements in a high degree. Albumen, dextrin, grape or cane sugar, starch solution, alcohol, &c., seem to have little or no power of destroying the motion, and the extraordinary properties of gum arabic have been noticed. I think it not unlikely that when these phenomena are fully investigated they will give strong support to a theory lately put forward by M. Becquerel, that the movements of fluids in animals and plants, which have often been attributed by Graham and others to osmose, are really due to minute electric currents.

Mr. DANCER, F.R.A.S., stated, that the subject which Professor Jevons brought before the meeting, was one to which he had paid attention at intervals for the last thirty years. He had repeated Dr. Robert Brown's experiments with the majority of the substances named in his paper, and had also experimented with a great number of other substances and different solutions.

The particles approaching a spherical form gave evidence of the greatest activity, with some few exceptions. The activity and duration of the movements vary according to their magnitude and also the solution in which they are suspended. For instance, some of the metallic oxides would exhibit the movement for some time, and then gradually get aground on the glass plate, and cease to move. There was some difficulty in reducing metals to particles sufficiently small and regular in form for the exhibition of the molecular movement; even hardened steel, when rubbed on a very fine hone, appears fibrous, and soft metals, such as platinum and copper, like shavings, under a high magnifying power. Those siliceous particles of the hone which have their lines of cleavage favourably situated are frequently detached in thin plates during the act of grinding, and form brilliant objects when viewed by polarised light. Metals reduced in this manner require re-grinding several times before they lose their fibrous character, and become sufficiently minute for successful experiments.

Metallic oxides vary considerably in their form and magnitude, according to the solutions from which they are precipitated. By practice it would be possible, in many cases, by their microscopical appearance, to name the solutions from which they had been precipitated. The activity of these, when of favourable size, say from the 1-30000th to 1-50000th of an inch, is very different, being great in water, solution of gum, sugar, &c., but quite inactive in oil.

Mercury and sulphur when sublimed assume a spherical

form, and although these spheres could be obtained from 1-1000th to 1-50000th of an inch in diameter, they do not exhibit any movement in water. He has sublimed them on to a drop of water, but they refused to sink. Possibly their polished surfaces retained a film of air which floated them. So transparent and perfect in form are the sulphur spheres that they distinctly exhibited the image of a lamp flame at their focal point. Triturated or precipitated sulphur will exhibit active movement in various solutions. As regards the cause of this so-called molecular movement, Mr. Dancer thinks that chemical action will not account for it. Diamond dust, graphite, and other refractory substances, are found to be active in water and solutions of gum. Nor is electricity a satisfactory explanation to him. He has found that particles did not show a marked alteration in their movements when exposed to electrical influence. The results of many experiments point to heat as a probable cause, and although the peculiar movements of these particles appear like electrical attraction and repulsion, similar movements might be caused by the changes of temperature of the particles transmitted through the solutions.

#### GLASGOW PHILOSOPHICAL SOCIETY:

(CHEMICAL SECTION).

Ordinary Meeting, January 31, 1870.

Dr. WILLIAM WALLACE, F.R.S.E., Vice-President, in the Chair.

Mr. JOHN CHRISTIE, of Alexandria Turkey Red Works, Dumbartonshire, read a paper on "*The History of Madder, the Various Investigations Relating to its Character and Composition, and the Proposed Sources of Artificial Alizarine.*"

The author, with considerable detail, traced the history of madder dyeing, from its origin in Eastern India, 3000 years ago, through Persia, to Adrianople, Greece, Italy, and Western Europe. The colours were first obtained from Munjeet; then came into use the Turkey madder root. This plant was first grown in England in 1624, at which time three qualities were known—cropp, fatt, and mill madders. In the year 1798 there were only eleven madder mills in the whole of France, while now in the département of Vaucluse alone there are no fewer than fifty in operation. French madder root has a peculiar smell, and a taste between bitter and sweet. Some kinds, as those of Alsace and Holland, when mixed with water and allowed to stand for some time, give a thick jelly; this is not yielded to the same extent by Avignon madder. If this madder is treated with an acid it produces a perceptible effervescence, owing to the quantity of calcic carbonate which it contains.

Towards the close of last century, scientific investigators and the more intelligent of the dyers and printers were led from various circumstances to suppose that madder contained two colouring matters, a red, and what they then called a tawny colour. The author mentioned the results of the investigations of Watt, Charles Bartholdi, and Hausmann, and stated that, in 1823, M. T. Kuhlman published a complete approximate analysis of madder. That chemist found a red colouring matter, which he specially searched for, and another matter of a fawn colour, which he did not consider worthy of investigation. He prepared the red colouring matter by steeping madder roots in water for twenty-four hours, then boiling the washed madder with a fresh quantity of water, filtering the decoction hot, and then adding sulphuric acid, when a flocculent precipitate of an orange colour was produced. He again filtered and washed the precipitate with acidulated water. What he thus obtained was his *matière colorante rouge*. This he purified by dissolving in absolute alcohol, to which a



small quantity of dry pulverised potassium carbonate was added; the alcohol acquired an intense crimson-red colour. After filtering and allowing the filtrate to evaporate spontaneously, he obtained small crystals like fern leaves, and having the following properties:—(1), Great solubility in alcohol, and imparting to it a beautiful red colour; (2), solubility in water, the colouring matter altering in the concentrated solution, and being precipitated; (3), the solubility in water greatly facilitated by alkalis without any material alteration of the shade; (4), it is precipitated as an orange colour from solutions by acids.

Mr. Christie next referred to the researches which were made on Alsace madder by Robiquet and Colin, and published in 1826. Those chemists obtained two colouring substances, one of them being what they considered no other than the particular colouring substance of madder, and which they named *alizarine*, from the modern Greek name for madder. The other substance they considered to be a modification of alizarine, and from the colour which it took when freed from the acid used to precipitate they called it *purpurine*. In the following year, by pursuing a somewhat different process, Gautier de Claubry and Persoz obtained two colouring matters—*matière colorante rouge* and *matière colorante rose*. Their distinctive properties are thus shown:—

<i>Red.</i>	<i>Rose.</i>
Fracture brilliant.	Fracture resinous.
Attacked by ammonia warm.	Attacked by ammonia cold.
Caustic alkalies give red colour.	Caustic alkalies give purple colour.
Insoluble in alum liquor.	Freely soluble in alum liquor.

In the hands of the same chemists madder yielded, by treatment with sulphuric acid, and subsequent washing with cold water, a preparation of great tinctorial power, which was at first called *sulphuric carbon*, and sometime later *garancine*. The manufacture of this substance on the large scale was undertaken by MM. Lagier and Thomas, of Avignon, in 1829.

The author gave a full outline of the investigations which Dr. Edward Schunck made in 1848. Seven substances were obtained by Schunck: two colouring bodies, two resins, a bitter substance, pectic acid, and a dark brown substance. One of the colouring bodies was alizarine, to which he gave the formula,  $C_{14}H_{10}O_4$ ; for the other, which he named *rubiadin*, he proposed the formula  $C_{32}H_{22}O_{10}$ . Pursuing a different process, Dr. Debus, in the same year, investigated Zeeland madder. He called one of the colouring bodies *lizaric acid*, and proposed for it the formula  $C_{30}H_{20}O_9$ ; and the other he called *oxy-lizaric acid*. Its composition was—

Carbon .. .. .	66.40
Hydrogen .. .. .	3.86
Oxygen .. .. .	29.74
	<hr/>
	100.00

The last mentioned substance was obtained to the extent of about 4 or 5 grains from 20 lbs. of madder.

Drs. Wolff and Strecker, pursuing a process very similar to Schunck's, obtained, in the year 1850, both alizarine and purpurine. The latter they regarded as oxide of alizarine. Their conclusions were summarised thus:—

I. Madder contains two colouring matters—alizarine and purpurine.

II. Alizarine changes into purpurine when madder is fermented.

III. Alizarine and purpurine, when oxidised with nitric acid, give phthalic acid.

IV. Chloronaphthalic acid is chloride of alizarine.

According to Strecker, if the formula of alizarine be taken as  $C_{10}H_6O_3$ , and one atom of chlorine be substituted for one atom of hydrogen, an interesting relationship is observable between that compound and chloroxynaphthalic acid,  $C_{10}H_5ClO_3$ . The author said it would thus seem likely that alizarine, or a body very similar to it, might be

produced from chloroxynaphthalic acid. Schützenberger and Lauth have replaced the chlorine in that compound by hydrogen, but the new body had not the properties of alizarine, the composition of which, according to Schützenberger, is very probably  $C_{20}H_{12}O_6$ . P. and E. Depouilly, by boiling chloride of chloroxynaphthalic acid,  $C_{10}H_5ClO_3 \cdot Cl$ , with solution of potash, and subsequent treatment with mineral acids obtained as a yellow crystalline powder, a body which sublimed in beautiful needles, and whose alumina salt is a deep red, like the colour given by madder. The iron salt is nearly black, and although it resembles alizarine in many points, Schützenberger states that trials made at Mulhouse to use it had not been satisfactory.

The next point referred to in the history of alizarine was the fact that Dr. Anderson, of Glasgow, had treated opianic acid,  $C_{10}H_{10}O_5 (= C_{10}H_6O_3 + 2H_2O)$ , with sulphuric acid, and obtained a colouring matter which was probably alizarine, as it yielded all the madder colours on alumina and iron mordants. According to Clark, who obtained a patent for the process in 1861, artificial alizarine is obtained from dinitronaphthaline, and is capable of yielding all the madder colours. More recently Professor Rochleder, of Prague, has obtained, besides alizarine and purpurine, a small quantity of a colouring matter which reacts very like chrysophanic acid obtained from rhubarb root. When crystallised from absolute alcohol it has the composition  $C_{14}H_{10}O_4$ , and when it is distilled with powdered zinc it yields anthracene,  $C_{14}H_{10}$ . Graebe and Liebermann noticed that natural alizarine by distillation with powdered zinc, yielded a hydrocarbon which, instead of being naphthaline,  $C_{10}H_8$ , as they expected, proved to have the same composition as Dr. Anderson, Berthelot, and others had given to anthracene, and believing that this was the proper source to start from in the preparation of artificial alizarine, they set to work to test the truth of the opinion. They were so far successful that they obtained a product closely allied in many of its properties to the colouring matter of madder, and in December, 1868, they obtained provisional protection for their process in this country. Mr. Christie detailed the process, stating that the patentees obtain in the first stage of the process anthrachinon,  $C_{14}H_8O_2$ , by the use of bichromate of potassium—



In the second stage they convert the anthrachinon into bibromanthrachinon,  $C_{14}H_6Br_2O_2$ , a solid substance which is purified by crystallisation from benzol. In the third stage this new compound is transformed into artificial alizarine by treating with potash, heating to  $180^\circ$  or  $260^\circ$  C. till a deep blue colour results, then dissolving in water, filtering, and precipitating the alizarine by acid. They obtained provisional protection for a second patent last year.

Pursuing a somewhat different course, Julius Bröner and Hermann Gutzkow, of Frankfort-on-the-Maine, matured a process which they patented in May, 1869, and which, they state, yields two colouring matters that can be employed for dyeing or printing, either with or without mordants. One of them colours alcohol yellow, and the other colours it red or violet.

Mr. Christie completed his historical *resumé* by referring to Mr. W. H. Perkin's process, patented 26th of June, 1869, by which artificial alizarine is obtained from anthracene, by oxidising with bichromate of potassium to produce anthrachinon—a process which has recently been modified by the use of a new acid derived from anthrachinon in place of bibromanthrachinon.

The author then referred, at considerable length, to experiments which he had recently made with Perkin's artificial alizarine, and with one made by a secret process by M.M. Lucius and Co. of Hoechst, near Frankfort. Amongst other things, he stated that while natural alizarine, prepared from the finest garancine, fused at  $320^\circ$  F., and was almost entirely sublimed by exposure to a temperature of  $340^\circ$ , the artificial alizarine only yielded a sublimate when the temperature was raised to  $420^\circ$  F.



There was no fusion, and only 15 per cent of the powder was sublimed, even though it was kept at a temperature of 450° for a whole hour. No fusion ensued, and no further sublimate was produced, though the powder was slowly heated to 600°, at which temperature it was kept exposed for some time. Mr. Christie showed to the members an interesting experiment to demonstrate the truth of his opinion that artificial and natural alizarine are not identical. He placed swatches of dyed cloth in caustic soda solution (30 grs. to the gallon of water). Those dyed with the artificial alizarine of Perkin and Lucius and Co., in a short time threw off a deep crimson colour, which rose to the surface of the cloth, and, flowing down the swatch, fell in streaks through the alkaline liquor; while those dyed with natural alizarine and with garancine threw off no colour to affect the soda solution. He had found that selected crystals of artificial alizarine had only one-half the tinctorial power of the natural product. He concluded by saying that, from the several experiments which he had made, his opinion was that, although the substance now sold as artificial alizarine may be the best attempt to produce the alizarine of madder by chemical means, in its present state it is far from being identical with it.

A very animated discussion followed, in which Messrs. Anderson, Hogg, J. W. Young, Smith, Paterson, and the Chairman took part.

Mr. HOGG strongly combated the opinion that the two products are not identical. He questioned the absolute purity of Mr. Christie's artificial alizarine, and said that, unless it was not only sublimed, but several times recrystallised from alcohol, it would be impure; and, further, that the colouration imparted to the alkaline liquor was doubtless due to the presence of another colouring matter which is known to be present in ordinary commercial artificial alizarine. He also stated that mordanted cloth dyed with pure artificial alizarine stands soaping better than that dyed with garancine: that was the testimony of many persons who had worked with the colour.

Mr. J. W. YOUNG said that he had found that cloth prepared with the artificial alizarine would stand even boiling with soap.

Mr. SMITH stated that he considered that he had established the identity of the crystals of the two products by microscopic examination.

In proposing a vote of thanks to Mr. Christie, the CHAIRMAN referred to the highly interesting nature of the enquiry, and complimented that gentleman upon the extensive researches in which he had been engaged, as shown by his very elaborate paper. The proposal was most heartily agreed to.

## CORRESPONDENCE.

### THE BESSEMER PROCESS FOR MAKING STEEL.

*To the Editor of the Chemical News.*

SIR,—Mr Norman Lockyer, in his lectures upon the spectroscope, delivered a few weeks ago before the Society of Arts, stated that this instrument was of great service in directing the Bessemer process of making steel; I have, however, been informed by others that it is perfectly useless for this purpose, since it does not afford any indication denoting that the blast has been kept on for a sufficient length of time.

Perhaps Mr. Lockyer, or some other gentleman, will kindly publish sufficient of his *practical experience* to settle this question. Such an act of courtesy will oblige both your correspondent and many other students.—I am, &c.,

A. B.

## MISCELLANEOUS.

**Sweating Gold Coins.**—The trial of Clifford for sweating gold coin presents many points of interest. It is the first case of the kind for thirty years. The facts were as follows:—The attention of the police being directed to a number of light sovereigns that found their way into circulation in a certain district, the coins in question were traced to a little girl, who, it appeared, acted for her father. When Clifford was arrested, he was seated in front of a battery, and although he may not have been working at the moment, still two sovereigns, each light to the extent of nearly two shillings, were found in his pocket. The scientific witness, Mr. W. Chandler Roberts, clearly showed that the wires that had sustained the sovereigns in the decomposition trough had been attached to the positive or dissolving electrode, and that the battery had not been employed for electro-gilding. Clifford threw into the fire the contents of a tea-cup, and as the chemist of the Mint produced in court gold extracted from the cinders, it is probable that the fluid was the actual solvent employed. Commenting on this, the *Pall Mall Gazette* says:—"In an official report bearing the signatures of the late Master of the Mint and Colonel Smith, F.R.S., it was suggested that a Mint charge should be imposed upon gold coin sufficient to defray not only the first cost of manufacture, but also the expense of replacing the worn coin after a certain period by new pieces of standard weight. It was proposed that as a coin would fall below current weight in eighteen years, it should be brought to the Mint at the expiration of that period and exchanged for a new piece. The recent trial of Clifford for 'sweating' sovereigns by the aid of an electric battery, and more especially the evidence of the scientific witness as to the facility with which such an operation can be carried out, suggests that if the plan in question were adopted, a positive bribe would be offered to ingenious but dishonest individuals to tamper with the coinage, and then present the damaged coin for exchange at the Royal Mint."

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

*Under this heading will be found an encyclopaedic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

*Comptes Rendus des Séances de l'Académie des Sciences*, January 31, 1870.

This number contains the following papers relating to chemistry and sciences allied thereto:—

**Observations on the Process Applied by M. Adams to Produce Deposits of Nickel on Other Metals.**—M. Gaiffe.—The main gist of this paper is to prove that, whatever may have been the value of the scientific experiments made on the electro-deposition of nickel upon other metals by various scientific men, none of them have succeeded in establishing an industrially-available method for the electro-deposition of nickel upon other metals; and the author states that this part of the discovery is entirely due to M. Adams.

**Transformation of Octohedric Crystallised Sulphur into Insoluble Sulphur under the Influence of Light.**—M. Lallemant.—It is, the author says, a well-known fact, that M. Schroetter, of Vienna, proved that the action of sunlight converts ordinary phosphorus into red amorphous phosphorus. Sulphur, according to this author, is similarly affected by the direct action of sunlight, inasmuch as the sulphur, previously soluble in sulphide of carbon, and crystallisable, is converted into an amorphous modification insoluble in sulphide of carbon. The author placed a concentrated solution of



sulphur in the liquid just alluded to in a sealed tube, and exposed that tube some time to the action of the sun's rays, concentrated by a lens; this causes a copious precipitation of sulphur as an amorphous insoluble matter.

**Action of Magnetism upon Rarefied Gases.**—M. Daniel.

**Heat Evolved when Boron Combines with Chlorine and Oxygen.**—MM. Troost and Hautefeuille.—According to the authors, carbon, when combining with oxygen, only gives out 8000 caloric units; boron, under the same conditions, yields 14,400 caloric units; while, when boron combines with 3 equivalents of chlorine, 104,000 caloric units represent the heat set free.

**Mode of Division of a Limited Quantity of Acid between Two Bases Applied in Excess.**—M. Landrin.—The author has experimented with nitric acid and the oxides of zinc and lead; the average percentage result arrived at is—Oxide of zinc, 29.93; oxide of lead, 20.49; nitric acid, 49.58. As regards the manner of distribution of the nitric acid employed, the author finds that there exists the relation of 1 to 4—that is to say, that, for 1 equivalent of dissolved oxide of lead, there have been dissolved 4 of oxide of zinc.

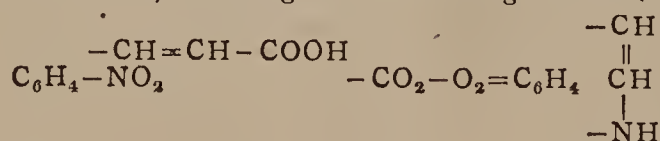
**Electrolysis of Oxalic Acid.**—M. Bourgoïn.—A lengthy paper on the electrolysis of oxalic acid. The main point of interest is that the group  $C_2O_3, 3HO$  suffers decomposition only.

*Berichte der Deutschen Chemischen Gesellschaft zu Berlin*, No. 19, 1869.

This number contains the following original papers and communications:—

**On Anthracen-Carbonic Acid.**—MM. Græbe and Liebermann.—When anthracen is heated, along with liquid phosgen, in sealed tubes, no action takes place until the temperature is raised to  $180^\circ$ , and the full reaction is only obtained by continuous heating to  $200^\circ$ . The result of this operation is the formation of anthracen-carbonic acid,  $C_{14}H_9.CO_2H$ ; this substance is almost insoluble in cold water, but can be obtained in crystalline state from its boiling-hot solutions in that fluid; the acid fuses at  $206^\circ$ , but loses some of its carbonic acid at  $150^\circ$ . The salts of this acid are soluble in water and alcohol; when the acid is submitted, while in solution in anhydrous acetic acid, to the oxidising action of chromic acid, anthrachinon is formed.

**Synthesis of Indol.**—MM. Baeyer and Emmerling.—In a lengthy paper, the authors describe the formation of indol, synthetically, from nitro-cinnamic acid, according to the following formula:—

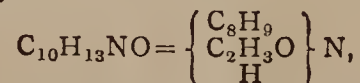


Azocinnamic acid, obtained by treating nitro-cinnamic acid with sodium amalgam, also yields indol when it is treated with an oxidising substance like, as for instance, peroxide of lead.

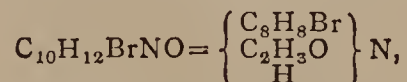
**Formation of Nitro Bodies (Nitrosokörpern).**—M. Baeyer.—The author states that only such nitrogenous substances as contain the imido group,  $NH$ , are capable of yielding, with nitric acid, nitro bodies or compounds. It is further to be observed that only such imido compounds as exhibit a basic character yield nitro derivatives, and quotes, as instances, that, whereas isatine and succinimide do not yield such nitro compounds, diethylamine, diglycolamidic acid, coniine, and other substances do. The paper discusses, at length, the *modus quo* and the origin of these combinations, and the relative position of the nitro group.

**Reduction of Angelic Acid to Valerianic Acid.**—M. Ascher.—When angelic acid is heated to about  $200^\circ$ , along with hydriodic and amorphous phosphorus, for about eight hours, it is entirely thereby converted into valerianic acid, as was fully proved by the elementary organic analysis of the silver and baryta salts of the last-named acid.

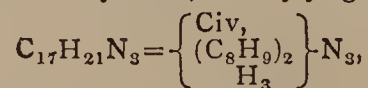
**Contribution to the Knowledge of Xylidine Derivatives.**—M. Genz.—Starting with perfectly pure xylidine, the author prepared:—Acetxylidide—



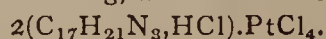
a solid substance, which fuses at about  $113^\circ$ , is readily soluble in alcohol and ether, and capable of crystallisation. Aceto-monobromxylidide—



also a solid substance. Mexylidine, or dixylidyl-guanidine—



a solid crystalline substance, difficultly soluble in water, readily soluble in alcohol and ether, combining, with chloride of platinum, to a salt—



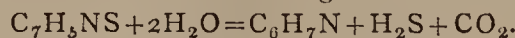
**Appendix to the Contributions on the Products of Desulphuration of Diphenyl-Sulpho-Carbamide.**—Dr. A. W. Hofmann. Too concisely written to admit of useful abstraction.

**Relation of Triphenyl-Guanidine to Sulphide of Carbon.**—M. Hobrecker.—



Triphenyl-  
guanidine.      Sulphide  
                    of  
                    carbon.      Diphenyl-  
                                    sulpho-  
                                    carbamide.      Phenyl  
  essential oil  
  of mustard.

The reaction proceeds further according to the following formula:—



**Avogadro's Law, as Derived from the Mechanical Theory of Gases.**—M. Naumann.—An algebraico-chemical essay.

**On Chloro-Phenol-Sulpho Acid.**—M. R. Bähr-Predari.—The author describes, at great length, several compounds obtained by him; the chief substance is a potassium salt,  $C_6H_4ClKSO_4 + 2H_2O$ , losing, at  $110^\circ$ , its water of crystallisation, fusing at  $245^\circ$ , and becoming decomposed at  $300^\circ$ .

**Determination of the Mineralogical Formula of some Mixed Rhombohedral Carbonates.**—M. Cossa.—This paper treats on the question whether, in such substances as dolomite, mesitine, and others, the carbonates of lime and magnesia, and of protoxide of iron and magnesia, are simply mixed or are chemically combined. The paper, however interesting in many respects, is too lengthy and too full of formulæ for useful abstraction.

**Incorrectness of the Thermo-Chemical Estimations and Researches made, by means of the Mercurial Calorimeter,** by MM. Favre and Silbermann.—M. Thomsen.—Chiefly a series of tabulated formulæ and figures.

**Methods of Distinguishing Molecular Compounds.**—M. Rathke.

**Molecular Weight of some Protoxide Combinations.**—M. Ladenburg.

**Third Paper containing the Results of the Researches on the Ethereal Derivatives of Acids and Alcohols.**—M. Henry.—Among a series of different products, the author describes, chiefly, monochloro-methyl-phenol,  $C_6H_4Cl(CH_3O)$ , a very mobile fluid, insoluble in water and in caustic alkaline liquids; soluble in alcohol and ether; sp. gr. at  $9^\circ$ , 1.182; boiling-point,  $200^\circ$ . Monochlorethyl-phenol,  $C_6H_4Cl(C_2H_5O)$ , also a liquid, boiling at  $210^\circ$ ; sp. gr. at  $9^\circ$ , 1.106. Monobromo-methyl-phenol,  $C_6H_4Br(CH_3O)$ , a liquid boiling at  $220^\circ$ ; sp. gr. at  $9^\circ$ , 1.494.

**Some Reactions of Anhydrous Sulphuric Acid, and a New Method of Formation of Oxysulphide of Carbon.**—M. Armstrong.—After referring to the labours of MM. Schützenberger, Rose, and Williamson on this subject, the author describes a series of experiments made with anhydrous sulphuric acid and sulphide of carbon, equivalent parts of which substances having been mixed and heated on a water-bath, give rise to the formation of oxysulphide of carbon and sulphur, according to the following formula:—



**Specific Heat of Gases, and the Correct Capacity for Heat.**—M. Horstmann.—An algebraico-physical monograph.

*Neues Jahrbuch für Pharmacie*, von Dr. F. Vorwerk, November and December, 1869.

These two papers, published together, contain the following original papers and memoirs:—

**Detection and Estimation of Arsenic in the Rosaniline (Fuchsine) of Commerce.**—Dr. Riecker.—This very lengthy paper is essentially devoted to the testing of the correctness of the methods for the quantitative estimation of arsenic, and the possibility of the quantitative estimation of arsenious and arsenic acid separately, when both these substances are present. As regards the qualitative detection of arsenic in fuchsine, the author states that the pigments of that name tested by him, and obtained from various sources, all contain arsenic in some form or other. That this quantity is not small may be inferred from the results of the author's quantitative analysis, from which we gather that a sample of fuchsine obtained direct from a manufacturer contained, on an average, 2.073 per cent of arsenious acid and 7.593 per cent of arsenic acid. Another sample, obtained from a wholesale druggery, contained, on an average (several analyses were made), 1.008 per cent of arsenious acid and 4.4705 of arsenic acid. This research was undertaken with the express view of testing the question, whether the use of fuchsine, as a colouring matter for syrups, sweetmeats, and the like, is or is not to be prohibited, as can be done in Prussia by a simple police order. It is quite evident that fuchsine should not be indiscriminately used for such purposes.

**Easy Method of Removing Gypsum from Water.**—Dr. Riecker.—The use of witherite, native carbonate of baryta, is recommended by the author to remove all the gypsum from water. Of course the quantity of the mineral to be applied for this purpose should be regulated according to the quantity of gypsum present in the water; but, as an instance, we may state that a water containing, in 10,000 parts, 4.37 parts of gypsum, requires about  $\frac{1}{2}$  lb. of witherite, ground to a fine powder, for every large pailful of that water. After the addition of the witherite, the water is well stirred, and next left at rest to deposit the sediment for twenty-four hours, and then run off for use. The water may be either boiled before or after this process, and will be found quite soft.

**Proper Arrangements of Pumps so as to Yield a Pure and Wholesome Potable Water.**—Dr. Riecker.—Attention is called to the necessity of excluding from pumps any surface, or drainage, or sewage waters, and to bore the wells to such a depth as to be out of the reach of such contaminations of the water to be used for domestic and industrial purposes.



Cosmos, February 5, 1870.

**Investigation of the Grotto of Montesquieu-Avantès (Ariège, France).**—M. Regnault.—The researches made by this author of the locality alluded to, lead him to agree with MM. Vogt, Broca, Strenstrup, and other savants, as to the anthropophagic nature of primeval man.

**Atmospheric Electricity of Haiti.**—M. Ackermann.—The island of St. Domingo, as it is also called, is situated between  $17^{\circ} 53'$  and  $19^{\circ} 58'$  N. latitude, and between  $70^{\circ} 45'$  and  $76^{\circ} 55'$  latitude W. from Paris. According to the author, who has, during a series of five years, made meteorological observations at Port au Prince, there have, on an average, been 129 days of each year either severe thunderstorms, or other very marked electrical phenomena, especially during the months of May, July, August, and September. Severe thunderstorms more frequently occur during day- than night-time. The year 1868 was especially remarkable for severe thunderstorms; during one of these, lasting for forty-five minutes, 400 lightning flashes were distinctly seen.

*Pharmaceutische Zeitschrift für Russland*, November, 1869.

This number contains the following original papers and memoirs relating to chemistry:—

**Monograph on Inuline.**—Dr. Dragendorff.—Continued from former numbers. This exhaustive paper is not yet ended.

**Preparation of the Amides of Polybasic Acids.**—Dr. Lösch.—The author prepared tartramide, citramide, and succinamide, by causing liquid ammonia to act upon the ethers of the acids referred to. The chief result of the author's researches on this subject is that, by the action of liquid ammonia (in aqueous solution), just alluded to, the neutral amides of the acids are only formed for a moment; but decomposition sets in, and other compounds result from the reaction, and it is, therefore, necessary to act upon the ethers referred to with an alcoholic solution of ammonia-gas when it is desired to obtain the amides of the acids.

**Artificial Kirschwasser.**—M. Reinsch.—The genuine alcoholic fluid of this name owes its flavour to the presence of a small quantity of hydrocyanic acid and ethereal oil of bitter almonds (hydruret of benzoyl). The author suggests that, when a certain quantity of the young leaves of the peach tree (a handful is named) is beaten up in a porcelain mortar, next digested with 4 litres of water during two days, and this mixture added to 2 litres of strong alcohol (94 per cent), and submitted to distillation, and the distillate diluted with water to a strength of 60 per cent alcohol, a fluid is obtained fully equal in taste and aroma to the best Swiss kirschwasser made from cherries bruised up with the stones and kernels they contain. The author cautions against the drinking of too large quantities of this liquor; and so he may, since cases of accidental poisoning with this and similar alcoholic liquors (Persico among the number) are by no means rare.

*Moniteur Scientifique*, No. 315, February 1, 1870.

This number contains the following original papers relating to chemistry and subjects allied thereto:—

**Direct Application of Wool-Suint (Fatty Matter containing a large quantity of Potassa Salts) to the Preparation of Prussiates and Cyanides.**—M. Havrez.—Suint contains some 40 per cent of potassa; and, when previously ignited, this alkali becomes thereby intimately mixed with strongly-nitrogenised animal charcoal. The author chiefly points out the profit to be derived from the use of suint for the manufacture of prussiates and cyanides, and to the paper is added a short report from M. Schattenmann, prussiate and cyanide manufacturer, at Bouxwiller, near Strasburg, who states that results of experiments made with suint by him, on the large scale, are decidedly favourable to the use of that substance for the purpose alluded to. It should be observed that the quantity of suint contained in raw wool amounts to one-third of its weight; and the author states, in a foot-note, that, since in 1867 there was imported into the United Kingdom 63,000,000 of raw wool from the Cape and Australia, the quantity of suint contained therein amounted to at least 20,000,000 kilos.

**Latent Heat of Volatilisation of Liquids.**—M. Koehler.—An algebraico-physical treatise.

**Artificial Alizarine.**—M. Kopp.—The author points out that there are at present several processes of preparation of alizarine by artificial means, which are entirely different from each other. After mentioning MM. Græbe and Liebermann, and Gutzkow and Broenner, the author states that Dr. Grieff, at Cologne, has just come forward with an entirely new process, which will be tried on the large scale by MM. Weiler and Co., of that city. Reference is made to the fact that the purified alizarine (artificially made by MM. Meister and Lucius) yields, on elementary analysis, in 100 parts—Carbon, 69.92; hydrogen, 3.34; oxygen, 26.74. The formula  $C_{14}H_8O_4$ , by some assigned to alizarine, requires, per cent—C, 70.00; H, 3.33; O, 26.67. The author enters, at some length, into the question, whether artificially-made alizarine, even if it be cheaply and abundantly produced, will prove, in all respects, a suitable substitute for madder, and comes to the conclusion, for good and sound reasons (too many to quote here, but which we fully endorse), that the very composition of madder is such as to ensure its continued use, and even preference above any of its single tinctorial elements, because the effects produced by madder and its commercial preparations are due to the joint action of all its tinctorial and some one or more of its other constituents.

**Soluble Iodine Green.**—MM. Kalle and Co. write from Biebrich, Nassau, Prussia, stating that they have succeeded in producing an iodine green soluble in tepid, and even cold water, without difficulty. This new material, moreover, does not contain picric acid, and, being less acid, does not require silicate of soda, for which borax is to be substituted. This dye yields so fast a colour that woollen tissues can be fulled after dyeing with it.

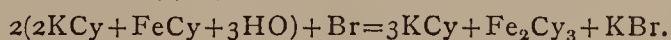
*Polytechnisches Journal von Dingler*, first number for December, 1869.

This number contains the following original papers relating to chemistry and allied sciences:—

**Experiments made with the view to Determine Percentically the Value of Fire-Clays.**—Dr. Bischoff.—In a lengthy paper, the author records a series of pyrometric experiments made with the view of ascertaining the value of such substances as pure silica, alumina, and mixtures of the same, in respect to resistance of fusion, and, also, of various native mineral products, known by different names and of very different mineralogical and chemical characters.

Second number for December, 1869.

**Preparation of Ferricyanide of Potassium, or Red Prussiate.**—M. Reichardt.—The author recommends the use of bromine, instead of the usual application of chlorine, to convert the ferrocyanide of potassium (yellow prussiate) into ferricyanide. 422.28 grms. of crystallised ferrocyanide require  $79.97 = 80$  of bromine = 100:19 = circa 6.33 c.c. The formula is—



Experiments made, on the small scale, with 50 grms. of ferrocyanide, proved that 9.5 grms. of bromine were required; and the operation is very rapidly finished. The author states that experiments made on the large scale answer exceedingly well.

**Chemical Analysis of a Sample of Extract of Meat.**—M. Reichardt.—This sample was prepared by a private firm, and yielded, on analysis, the following results:—Portion soluble in alcohol (of 83 per cent strength), 80.76 per cent; water, 16 per cent; fatty matter, 0.2 per cent; nitrogen, 9.99 per cent; ash, 21.36 per cent (containing potassa, 9.0 per cent; soda, 2.3 per cent; phosphoric acid, 6.1 per cent). These results, as compared with Liebig's and the Fray Bentos extracts, are stated by the author to be in favour of the extract tested by him for MM. Buschenthal and Co.

First January number, 1870.

**Substances Suitable to Agglutinate Coal-Dust.**—M. Jicinsky.—This paper is a valuable contribution to the proper methods of utilising coal- and coke-dust and small coals, and the manufacture of artificial fuel, but cannot be understood without reproduction of the engravings.

**Analysis of Pig-Iron.**—M. Richter.—The sample was obtained from a peculiar iron ore met with in Silesia. The sp. gr. of the iron = 7.361. It contained in 100 parts:—Iron, 90.041; copper, 5.343; cobalt, 0.666; nickel, a trace; arsenic, 0.013; silicium, 1.644; phosphorus, 1.464; sulphur, 0.404; combined carbon, 0.723; no molybdenum.

*Revue Hebdomadaire de Chimie*, January 20, 1870.

**Analysis of Some Extracts of Meat as met with in Commerce.**—M. Lebaique.—The number above quoted contains the results which we reproduce here; but a full account of the method of analysis employed is recorded in two previous numbers—viz., those of December 23rd and 30th. The author distinguishes the extracts by the figures A, B, C, D, and E, referring, respectively, to—Liebig's meat extract; La Plata extract; extract from M. Tooth, Sydney; extract of French Company in South America; extract of M. Whitehead, Sydney. **Organoleptic, or physical properties of the extracts:**—A. A firm, homogeneous, yellow-coloured substance, perfectly soluble in water, yielding a brown-coloured solution, and exhibiting a strongly-pronounced smell as well as taste, contains 7.5 per cent of water, 6.2 per cent of substances soluble in alcohol, 23 per cent of ash, and a total of 9 per cent of nitrogen.—B. (Two samples.) No. 1 is a somewhat soft, homogeneous, brown-coloured substance, imperfectly soluble in water (insoluble residue amounts to 2.5 per cent); the aqueous solution is brown-coloured, and exhibits a strong animalised smell and taste; it contains 9.0 per cent of water, 53 per cent soluble in alcohol, 21 per cent of ash, and a total of 9 per cent of nitrogen. No. 2 is a soft, brown-coloured, homogeneous substance, soluble in water, without residue, brown-coloured solution, odour and taste rather strong; it contains 16 per cent of water, 53 per cent soluble in alcohol, 18 per cent of ash, and a total of 9.6 per cent of nitrogen.—C. A soft, light brown-coloured, non-homogeneous substance, only imperfectly soluble in water (insoluble residue, 3 per cent); the aqueous solution is light brown-coloured, and odour and taste are rather strong; it contains 15 per cent of water, 54 per cent soluble in alcohol, 21 per cent of ash, and a total of 8.4 per cent of nitrogen.—D. A hard brown-coloured granulous substance, imperfectly soluble in water (1.5 per cent of insoluble residue); colour of aqueous solution, bright brown; taste and odour less strongly marked than that of the other samples; it contains 16.5 per cent of water, 28 per cent of matters soluble in alcohol, 9.5 per cent of ash, and a total of 10.7 per cent of nitrogen.—E. A soft, homogeneous, light brown-coloured substance, soluble in water without leaving any residue; colour of solution, brown; smell and taste, rather strong; it contains 17 per cent of water, 47 per cent of matter soluble in alcohol, 19 per cent of ash, and a total of 9.46 per



cent of nitrogen. The alcohol applied contained 90 per cent of absolute alcohol.

**Chemical Investigation of the Apples suitable for Cyder Making.**—M. Mène.—It appears that there has been held, at St. Lô (Brittany, France), a mixed congress, of scientific men and agriculturists, who have investigated this subject. The method of analysis, and the divers means employed to ascertain the following particulars, viz., sp. gr. of the juice, dry glucose, dry mucilage, tannin, free malic acid, divers malates, and water, are given at great length; and a tabulated form records the results obtained by the analysis of some twenty-four kinds of apples, stating the constituents for 1000 parts. The lowest sp. gr. of the juice has been found at 6.5, the highest at 11.7; smallest quantity of glucose, 122.0, highest, 194.0, for 1000 parts.

**New Reagent for the Estimation of Carbonic Acid in Combination in Bicarbonates and in Natural Waters.**—M. Lory.—The author employs phosphate of copper dissolved in a very slight excess of hydrochloric acid; the phosphate of copper is obtained by precipitating a solution of bichloride of copper with ordinary phosphate of soda. The precipitate is collected on a filter, well washed, and, after having been taken from the filter, suspended in water and dissolved by the addition of a few drops of hydrochloric acid. When this reagent is added to any water containing alkalies or alkaline earths in the state of carbonates or bicarbonates, the result is, at first, the formation of a bluish coloured cloudiness, or turbidity; by the addition of a larger quantity of this reagent, this turbidity disappears, and the liquid becomes clear again. This point having been reached, the quantity of the reagent applied will be proportional to the total equivalent of the bases present, and, consequently, to the carbonic acid which was combined with these bases. In order to titrate the reagent, dissolve 0.265 grm. (equal to 1-200th equivalent) of perfectly pure and dry carbonate of soda in water, and saturate this solution with carbonic acid, in order to convert it into bicarbonate (excess of carbonic acid does not at all affect the reagent). 4.4 c.c. of this solution upon 1 decilitre of pure water should produce, by the addition of the copper liquor, the reaction already alluded to, and these 4.4 c.c. correspond to 0.220 grm. of carbonic acid.

January 27, 1870.

**Manufacture of Hyposulphite of Soda with Alkali Waste.**—M. Mène.—Sulphate of soda is added to the alkali waste, which is spread out in regularly-formed heaps, or beds, and this mixture is left to the action of atmospheric air; the soda-salt alluded to is decomposed, and there is formed a large quantity of hyposulphite, which makes its appearance in the shape of efflorescences. When this has increased to a certain point, the mass is treated with water, and the aqueous solution is next treated with a weak acid, in order thereby to eliminate salts of lime and some sulphides. This latter operation also produces sulphur, since the sulphuretted hydrogen which is given off may be utilised.

**Useful Application of Mica.**—M. Mène.—In Germany, the doors of the steam-boiler furnaces are now very generally provided with square pieces of mica, properly fastened, by means of which the fireman is enabled to observe the fires without the necessity of opening the furnace doors too frequently, which is injurious, on account of interfering with the draft and proper course of combustion of the fuel, by reason of the access of irregular currents of cold air. Mica withstands a very high temperature, and the accidental breakage of these squares, or panes of this substance is thus inserted is guarded against by a properly-constructed iron wire-guard outside.

**Electrical Pyrometer.**—M. Becquerel.—Without reproduction of the cuts, this paper is not available for abstraction.

Les Mondes, February 3, 1870.

**Artificial Caoutchouc.**—M. Granier.—This material is a mixture containing gelatine and a variety of other substances (not specified) producing a homogeneous elastic substance, insoluble in mineral, as well as vegetable essential oils; not acted upon, moreover, by either coal or other hydrogenised gases. This material is now employed in France for a variety of purposes, too many to be here enumerated; its cost is only 3 francs per kilo.; and it melts readily at 100°, without decomposition, and can be cast into different moulds. Neither cold nor heat affect this substance, which, when completely oxidised, becomes more infusible than vulcanised caoutchouc.

**Crystallisation of Diamond, Rock-Crystal, and Tribasic Phosphate of Lime by means of Cold.**—M. Collas.—The author begins his paper with the following statement:—"The last of the subjects just mentioned is an accomplished fact; the second (speaking of rock-crystal) has been only half attained; and the first is, as yet, a hypothesis." The gist of the paper, which contains a lengthy description of experiments, may be summarised as follows:—"The hydrate of the basic phosphate of lime becomes horny by desiccation, pulverulent on being boiled, and crystalline by congelation. The precious-stones, which contain cavities filled with a liquid, are crystallised hydrates, and the liquid alluded to is a remnant of the water of the hydrate. A hydrate crystallises in a manner different from that of the crystallisation of a saturated saline solution. The crystallisation of a hydrate by cold (freezing) is a dissociation; the hydrated substance precipitates entirely in crystalline state. Lastly, the author states that it is a contradiction, so to say, to try to obtain crystallised carbon (diamond) by means of heat. The author's opinion concerning this crystalline carbon is that, at a very remote period of the existence of our globe, hailstorms of diamonds have taken place. And to the paper a map is added indicating, by means of a curved line, the *cercle diamantaire*—i.e., the area within which diamonds are now to be found. Graphite

is, according to the author, destroyed diamond—that is to say, diamond which has lost its crystalline state.

**Pre-Historic Man.**—M. Capellini.—The author has explored a grotto in the island of Galmeria, Italy, and found human and animal bones, mixed up with flint instruments, and several objects undoubtedly made by men. This grotto is so situated as to make its exploration not only difficult, but dangerous; yet it appears, according to the author, to have been inhabited, since traces of a fire-place were discovered therein.

## MEETINGS FOR THE WEEK.

MONDAY, 14th.—Geographical, 8.30.

— Medical, 8.

— London Institution, 4.

TUESDAY, 15th.—Royal Institution, 3. Professor Humphry, "On the Architecture of the Human Body."

— Institution of Civil Engineers, 8.

WEDNESDAY, 16th.—Society of Arts, 8.

— Meteorological, 7.

THURSDAY, 17th.—Royal Institution, 3. Prof. Odling, "On Chemistry."

— Royal, 8.30

— Zoological, 4

— Chemical, 8.

— Royal Society Club, 6.

FRIDAY, 18th.—Royal Institution, 8. Mr. Clifford, "Theories of the Physical Forces."

— Geological, 1. Anniversary.

SATURDAY, 19th.—Royal Institution, 3. Mr. Max Müller, "On the Science of Religion."

## TO CORRESPONDENTS.

\* \* With the present number, our subscribers will receive, in a convenient form for constant reference, a copy of the Regulations for the Sale and Dispensing of Poisons required by the "Pharmacy Act, 1868." The Pharmaceutical Society have the power to compel a strict compliance with the requirements of the Act; and we are glad to find that the Council are losing no opportunities of explaining to those concerned the conditions under which poisons can be legally sold or dispensed.

**Joseph Welch.**—A work, by the Editor of this journal, treating on the madder extracts and pigment colours is in the press.

**March.**—It cannot be made. (2) The various processes for the manufacture of artificial alizarine are all patented. (3) Messrs. Walker's address is 43, Mansell Street, Aldgate, E.

George E. Davis, Rev. E. Smith, Professor Smith (Sydney), Professor A. M. Thomson (Sydney), J. Gulson Burgess, and J. W. Slater. These correspondents are thanked for their communications, which shall receive due attention.

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# THE CHEMICAL NEWS.

VOL. XXI. No. 534.

## ON SOME REMARKABLE SPECTRA OF COMPOUNDS OF ZIRCONIA AND THE OXIDES OF URANIUM.\*

By H. C. SORBY, F.R.S.

WHEN a scientific man has been led into an error, and afterwards discovers his mistake, I think it a matter of duty that he should take an early opportunity to correct it. I therefore now write the following notice of certain remarkable peculiarities in the spectra of some compounds of the oxides of uranium with zirconia, which led both myself and others† to conclude that they were due to a new elementary substance.

Though the spectra of the different salts of those bases which show well-marked absorption-bands often differ in detail, yet they usually resemble each other so much that there is no difficulty in recognising each particular element. This is so constantly the case in the various compounds of erbium, didymium, and cobalt, and in the ordinary salts of uranium, that, for a long time, the more I studied this question, the more did it appear to be a general rule; and there seemed to be no reason to suspect that a few special compounds of uranium would give spectra with absorption-bands as unlike as possible those of all others. Such, however, turns out to be the fact, when its oxides are combined with zirconia.

As an excellent illustration of important differences in mere detail, but general correspondence, I would refer to the spectra of didymium in different states of combination,‡ and would especially refer to the the most distinct of the numerous absorption-bands, which occurs in the yellow. The various compounds agree in showing this band in the same general position; but, by careful management, and by the use of sufficient dispersive power, it may be resolved into a very variable number of narrow bands or black lines. For example, in the case of the crystallised sulphate containing comparatively little lanthanum, it can be resolved into seven narrow lines, two of those near the centre being the darkest; whereas, when much lanthanum is present, one line on the side next the green is so much darker than the rest, that the others are comparatively absent. On fusing the mixed oxides with borax, the same spectrum is seen as with oxide of didymium alone, and I can resolve the above-named band into only two narrower bands; whereas, when the saturated bead is made to deposit crystals by being kept some time at a very dull red-heat, this band can easily be resolved into eight equal and very distinct black lines. Although these and similar differences, in detail, are of much interest, yet in no case are they so considerable as to prevent our recognising at once that the spectra are all due to didymium. It is also important to notice that the amount requisite to give a most splendid spectrum, when the bead is crystalline, will scarcely show any trace of bands when in a vitreous condition, dissolved in the borax. This is analogous to what occurs in the case of solid and powdered crystals of sulphate of didymium; for the absorption-bands in the spectrum of the light transmitted by a thin layer of the fine powder, strongly illuminated from the other side, are as distinct as in that transmitted by a many times greater thickness of

solid and transparent crystal. We may very conveniently take advantage of this fact in studying the spectra of such substances when the amount of material at command is otherwise too small. This seems to be because the transmitted light does not simply pass through the crystals, but is in great measure reflected from them backwards and forwards, and thus, as it were, passes through a greater thickness. It is also to a considerable extent similar to that reflected from the powder when illuminated from above, as may be clearly proved by what occurs in the case of uranic salts. These, when in a state of moderately fine powder, transmit light giving a spectrum showing not only the absorption-bands in the blue, which alone are met with in that transmitted by a clear crystal, but also those in the green, which depend on fluorescence, characteristic of that reflected from the powder.\* These two kinds of bands can be easily distinguished by means of a plate of deep-blue cobalt glass, which has an entirely different action according as it is placed below or above the object, when the bands are due to fluorescence, but has no such effect when they are due to ordinary absorption. It would, perhaps, be well to mention here that I have in this manner proved that the abnormal bands seen in the spectra of the compounds of zirconia with the oxides of uranium, described in this paper, are due to genuine absorption, and not to fluorescence.

The remarkable spectrum of some jargons has been already described by me in the *CHEMICAL NEWS* (vol. xix., p. 122) and in the *Proceedings of the Royal Society* (vol. xvii., p. 511). One of its most striking peculiarities is that, when light passes in a direction perpendicular to the principal axis of the crystal, and the spectrum is divided by means of a double-image prism into two spectra, having the light polarised in opposite planes, though some of the absorption-bands are of equal intensity in both images, yet others are comparatively absent, some in one and some in the other; whereas, in the case of other dichroic crystals which give spectra with absorption-bands, they are usually all more distinct in one image than when the light is not polarised, and all fainter, or even comparatively absent, in the other. No sooner had I observed this spectrum than I made various experiments in order to ascertain whether uranium was present or not; and the then known tests that could be applied to the amount of material at my command seemed to show that it was absent. This was quite in accord with the results of the various analyses published by other chemists, none of whom mention the existence of any trace of that substance. Moreover, the general character of the spectrum was entirely unlike that of all the known compounds of uranic oxide. The various artificial salts all agree in giving a variable but small number of moderately broad absorption-bands in the blue end; and the same is also seen in the case of several natural minerals; whereas the jargon gave a most unusually large number of narrow black lines (fourteen quite distinct, besides others more faint and a single broader band which I cannot separate into lines), extending from the red end; so that nearly all occur in that part of the spectrum which is entirely free from bands in all previously-known compounds of uranic oxide. This same general fact was also seen in the spectrum of the opaque blowpipe beads gently flamed, as described in my former paper.

I will not now enter into a description of the various chemical and physical facts which seemed to warrant the conclusion that zircons sometimes contain a new earth; but, taking these into consideration, there seemed to be every reason to believe that spectra which thus differed so much from those of any previously-known substance were characteristic of this new earth. Judging from the facts then known, it was more probable that spectra of such a new type were due to a new element than that they were due merely to a combination of two such elements as zirconium and uranium. Some of these chemical and physical

\* Read before the Royal Society, February 10th, 1870. Revised by the Author for the *CHEMICAL NEWS*.

† Professor Church's paper, *CHEMICAL NEWS*, vol. xix., p. 121, and Professor Loew, vol. xx., p. 9.

‡ See also Bunsen's paper, *Pogg. Ann.*, vol. cxxyiii., p. 100.

\* See Stokes's papers, *Phil. Trans.*, 1852, p. 463, and 1853, p. 392.



facts can now be explained by the presence of uranium; but, besides this and several of the more common earths and oxides, I have detected, in some zircons, erbium, didymium, yttria, and another substance, which exists in such small quantity that I have not yet been able to ascertain whether or no it is the suspected new earth. These accidental constituents do not, indeed, occur in sufficient quantity to be of importance, except as modifying the physical and optical properties, the didymium giving usual characteristic absorption-bands (zircons from Svene-roe, Norway), and the manganese the same spectrum as that of garnets (zircons from an unknown locality in Siberia).<sup>\*</sup> This method, however, fails to give evidence of a new earth; for, since the publication of my former paper, I have proved that the very abnormal spectra, which seemed sufficient to establish its existence, are really due to compounds of zirconia with the oxides of uranium, which have such a powerful action on light that an almost inappreciable amount is sufficient to produce the spectra to great perfection—in fact, so small an amount that the total quantity which misled me was only a few thousandths of a grain; and its presence might easily have remained unsuspected if I had not made a number of experiments which, at first, did not seem to have much connection with the subject.

In studying the spectra of crystalline blowpipe beads, it seemed desirable to examine those made with carbonate of soda, with or without a little borax. This, when melted, dissolves certain oxides; and, though it crystallises on cooling, so as to be only partially translucent, yet, with strong direct sunlight, well-marked spectra may be seen. For example, in the oxidising flame, uranic oxide is easily dissolved by carbonate of soda alone, and, when quickly cooled, an orange-coloured bead is obtained, probably containing uranate of soda in a vitreous condition, which gives a single well-marked absorption band in the green with so small a quantity of the oxide that, in a bead  $\frac{1}{8}$  inch in diameter, 1-2000th grain shows the spectrum to the best advantage, and even 1-10,000th grain can be easily detected. We need not be surprised that this spectrum differs so much from the usual type of uranic salts, since, in this case, the oxide plays the part of an acid. It may be only an accidental coincidence, but this difference is analogous to what so commonly occurs on adding an alkali to neutral solutions of vegetable colours.<sup>†</sup> When gently re-heated, it seems as if the uranate passed into a crystalline state, for the spectrum then shows four absorption-bands, and is more like the ordinary type; but this change does not occur if a little borax had been added. The addition of more and more borax causes the absorption-band to become more and more faint, and to advance towards the blue end, until we obtain a spectrum with very faint bands, but of the usual character.

In examining the various products into which I separated jargons in order to study the supposed new earth in a state of purity, I obtained a small quantity of a dark-coloured substance (apparently zirconia) containing some oxide, which communicated a green tint to a glassy borax blowpipe bead, but yet not sufficiently distinct to show that it was due to uranous oxide. I therefore thought that the carbonate of soda method might throw light on the question; and, though the presence of zirconia prevented solution by pure carbonate of soda, the addition of a little borax enabled me to prove that uranic oxide is really present in some jargons. Such, then, being the case, it seemed desirable to ascertain whether the oxides of uranium would give rise to any special spectra when present along with zirconia in crystalline blowpipe beads. To my astonishment, I found that the spectra were precisely the same as those obtained in the case of what I had thought to be an approximately-pure new earth. When, however, I had ascertained the quantity of oxide requisite to give this result, I was no longer surprised

that I had not suspected its presence. In the case of transparent blowpipe beads of borax with microcosmic salt, it is requisite to have as much as about 1-50th grain of uranous oxide to show faintly the characteristic absorption-bands; whereas, when present along with zirconia in the crystalline beads, 1-50,000th grain gives an equally well-marked spectrum; and 1-2000th grain shows it far better than a larger quantity, which makes the beads too opaque. These very minute quantities were obtained by the repeated division of a small known weight, either before or after fusion with borax. This spectrum also differs very considerably from the spectra of the usual salts or blowpipe beads of uranous oxide. On comparing them side by side, the only common peculiarity is the fact of there being numerous absorption-bands distributed over a large part of the spectrum, but they do not correspond in either number or position; on the contrary, they differ almost as much as possible; and the darker bands in the spectrum of this zirconia compound occur where the transmitted light is the brightest, in other cases.

The oxide of uranium is so easily reduced at a high temperature to the state of protoxide in a borax bead with excess of boric acid, and is so readily peroxidised at a dull red-heat when crystallised along with borate of zirconia, that there seemed good reason to refer the change in the spectra to temperature rather than to the state of oxidation, until after it was found that they were due to uranium. By gently flaming the crystalline bead, the spectrum is entirely altered to that which seems to be characteristic of the compound of borate of zirconia with uranic oxide. This shows a spectrum with five well-marked absorption-bands, all of which occur at the red end, where there is no trace of bands in the case of the ordinary compounds of uranic oxide. I have tried many experiments in order to ascertain whether any other element besides zirconia will cause uranium to give similar abnormal spectra; but none show anything of the kind—at all events in similar conditions. A few have special characters, as described below; but the majority exert little or no influence; and, even when the blowpipe beads are crystalline, they show only the usual spectra of the oxides of uranium. Moreover, no such great change in the character of the spectra of any other elements which give absorption-bands is to be seen when they are combined with zirconia; and, as far as my present experience goes, it seems as if such very abnormal spectra were met with only in the case of these remarkable compounds of zirconia with the oxides of uranium.

Such, then, being the facts, it appears to me that we are now in a position to explain why certain zircons give three different spectra, as described in my former paper. Some jargons (usually those of a green tint) contain a little uranium so combined that the characteristic spectrum is only faintly visible; whereas, after ignition, the intensity of the absorption-bands is permanently increased to a variable extent, occasionally only a little, but, in some cases, as much as twenty-five times. This more powerful action on light is accompanied by an increase in hardness and in specific gravity (sometimes as much as from 4.20 to 4.60), as described in my former paper; and I have since found that these changes are approximately proportional to the amount of uranic oxide in the various specimens, as shown by comparing the spectra of the blowpipe beads. This change may partly depend on the oxidation of the uranous oxide, since some specimens slightly increase in weight when ignited; but I think it cannot be mainly due to that, for sometimes there is no such increase; and uranous oxide, combined with zirconia, gives rise, not to a spectrum without bands, but to one with several of very marked character, as described below. On the whole, since this abnormal type of spectrum is so characteristic of combination with zirconia, it appears to me more probable that the effect of a high temperature is to cause the uranic oxide to combine more specially with the zirconia, as though the greater part existed naturally

<sup>\*</sup> For both of these I am indebted to my kind friend Mr. David Forbes.

<sup>†</sup> See my paper in *Proc. Roy. Soc.* 1867, vol. xv., p. 433.



as a silicate, but after ignition as a zirconiate. We may also apply the same explanation in the case of zircons more or less strongly coloured by other oxides, which become almost colourless when heated; and thus this unexplained peculiarity of zircons may depend on the fact of zirconia being able to play the part of both a base and an acid, which, as compared with silica, has an affinity for bases varying according to the temperature.

The brown-red zircon from Ceylon (named at page 514 of my former paper, kindly presented to me by Mr. E. L. Mitford, of Rusthall) gives a spectrum precisely like that of the borax blowpipe beads crystallised after treatment in the deoxidising flame, and, therefore, no doubt contains uranous oxide. This spectrum, being given by only one part of the crystal, probably depended upon the presence of some substance which either reduced the uranic oxide or prevented the oxidation of the uranous.

These facts thus clearly show that the various spectra which seemed to indicate the presence of a new element existing in three different physical conditions are, in reality, only characteristic of the two oxides of uranium, combined with zirconia or not in combination. Perhaps some may think that my having been thus led astray shows that little or no reliance can be placed on the method of investigation employed; but I contend that the mistake was due to its being such an unexpectedly delicate test for uranium; and, as explained above, the error was ultimately corrected by a further development of the same method. As far as the interests of science are concerned, there is no need to regret the general result. We have lost what appeared to be good evidence of a new earth, but have gained an almost entirely new system of blowpipe testing, which enables us to detect such a minute quantity of some substances as could not be recognised by the ordinary means. I shall not now attempt to give anything like a full account of this subject, since it would be much better to let it form part of a paper on various improvements in blowpipe chemistry, but will merely mention a few facts which have a special bearing on the question before us.

In the first place, I would say that zirconia and the oxides of uranium are most useful reagents in detecting the presence of certain substances, with which they unite to form compounds having very special characters. The most striking of these are the compounds already described, which are distinguished by the spectra, and not by any well-marked colour—the compound of ceric oxide with uranic oxide, which is of a splendid deep blue colour, but shows no absorption-bands; and that of yttria with uranic oxide, which is characterised by a deep orange-colour and extreme fusibility. Thorina and oxide of lanthanum form with uranous oxide compounds which give spectra with absorption-bands in special positions, but of the usual type, and not of such a marked character as to be useful in detecting minute quantities of those substances in mixtures.

In order to see the spectra of the zirconium-uranium compounds, it is requisite that their oxides should be combined in a crystalline condition. When both constituents are melted in borax and are held in solution, or if when crystals are deposited any other substance replaces either the zirconia or the oxides of uranium, the characteristic spectra cannot be seen. The most simple application of this test for uranium is in the case of various zircons. As much of the powdered mineral as will dissolve should be melted with borax in a circular loop of platinum wire about  $\frac{1}{8}$  inch in diameter, so as to give a bead of moderate thickness. A little boric acid should then be added, which not only tends to keep the uranium in the state of protoxide, but also facilitates the crystallisation of the borate of zirconia, which is far less soluble when there is excess of boric acid. The bead should then be kept at a bright red heat, just within the deoxidising flame, until so much borax has been volatilised that small needle-shaped crystals begin to be deposited, when it must be allowed to cool rapidly. It should then be transparent with scattered

crystals, and the uranium all in the state of protoxide. On gently re-heating it, the bead ought to suddenly turn white and almost opaque; and care must be taken not to heat it any more than is just requisite to cause the borate to crystallise out, or else the uranium will rapidly pass into the state of peroxide. Such beads must be examined by strong direct light from the sun, or from a lamp of very great brilliancy, condensed on them by means of an almost hemispherical lens of about  $\frac{1}{2}$  inch focal length; and in addition to the means described in my former paper, I have since found it very convenient to place them over a hole in a black card, so as to entirely prevent the passage of any light which has not penetrated through them, even when so arranged in the focus of the microscope that the spectrum of their thin edges may be examined, if the centre be two thick and opaque. If thus properly prepared, the presence of more or less uranium will be shown by the greater or less intensity of the absorption-bands of the spectrum described and shown in Fig. 1 of my former paper. This test is so delicate that there is no difficulty in seeing the darker band in the green in the case of zircons which contain no more than 1-10th per cent of uranic oxide; and I find that very few localities yield this mineral so free from it that it cannot be easily detected. Those from Miask, Siberia, are the only specimens in which I have not been able to recognise it. The jargons from Ceylon contain an amount varying up to about 1 per cent, although in no published analysis that I have seen is there any allusion to the presence of even a trace. It has also been overlooked in several other cases; and it now becomes important, because it gives rise to various well-defined spectra, which are so characteristic of the different minerals, that they can be very conveniently identified, even when cut and mounted as jewels, by means of the number and position of the absorption-bands, as I intend to explain in a paper on the spectra of minerals.

In applying this test to detect minute quantities of uranium in other minerals, it is requisite to bear in mind that zirconia may play the part of both an acid and a base, and that various oxides and acids so combine with the zirconia or the oxides of uranium as to prevent the formation of the compounds which give rise to the characteristic spectra. The zirconia appears to combine with some rather than with the uranous oxide, and with others rather than with the uranic, so that, if one spectrum cannot be obtained, the other may; and there are few, if any, cases when neither can be seen, especially if care be taken to use excess of zirconia. If, however, the amount of uranium be very small, and so much of other oxides be present as to make the bead very dark, or too opaque from deposited crystals, before it is sufficiently concentrated for the compounds with the oxides of uranium to crystallise out, it may be impossible to detect it. In order to apply the test in the case of complex minerals, a bead of borax, boric acid, and pure zirconia should be prepared, then a small quantity of the mineral added, and, after fusion and sufficient concentration, the bead made to crystallise in the manner already described. If needle-shaped crystals be not deposited in the bead when very hot, and if it do not suddenly turn opaque when re-heated, the result may not be satisfactory. In this manner it is easy to detect uranium in 1-200th grain of such minerals as Fergusonite, tyrite, and yttriotantalite, even when they contain no more than 1 or 2 per cent. If, in such cases, the spectrum of the uranous compound cannot be obtained, the bead should always be flamed and re-examined, to see if that of the uranic compound is thereby developed.

In a similar manner, we may make use of a little oxide of uranium to detect zirconia; but the test is far less delicate than the converse, because it is almost impossible to obtain the compound in a crystalline state, unless there be an excess of zirconia. Not more than 1-1000th grain of uranic oxide should be employed, or the bead may be too opaque. There is no difficulty in thus detecting zirconia in zircons, or in katapleilit; but the presence



of so much of other bases in minerals like eudialyte prevents our obtaining a satisfactory result. There certainly could not be a more characteristic test to confirm the results of other methods, or to identify such a small quantity of approximately pure zirconia as could not easily be distinguished in any other way.

The only other compound of uranic oxide of very abnormal character which I have so far discovered is that with ceric oxide. So much of both should be fused with borax in the oxidising flame as will yield a bead which is perfectly clear and of pale yellow colour when rapidly cooled, but crystallises when gently re-heated. If the constituents be present in a certain proportion, it then turns from pale yellow to a deep blue, as though coloured by oxide of cobalt. In most cases, the bead is rendered nearly opaque by the number of crystals; but sometimes, though it turns deep blue, it remains transparent, owing to the compound being set free in a state similar to that of the red oxide of copper in a borax blowpipe bead, with carbonate of soda and oxide of tin, treated in the reducing flame. The spectrum of these blue beads shows no absorption-bands, but merely a general absorption at the red end; and it is curious to find that the combination of two yellow substances gives rise to a deep blue, in much the same manner as when the yellow ferrocyanide of potassium is added to a yellow ferric salt. The production of this blue colour, on the addition of a little uranic oxide, might be employed with advantage to identify moderately small quantities of cerium, even when mixed with a number of other substances; but, unfortunately, the presence of much oxide of lanthanum, which is so commonly associated with it, interferes, as though the ceric oxide had a stronger affinity for the oxide of lanthanum than for uranic oxide.

The most characteristic peculiarity of the compound of yttria and uranic oxide is that it will not crystallise out from a borax blowpipe bead, and that the affinity of the uranic oxide for yttria is stronger than for zirconia. Perhaps erbia may prove to act in the same way, but I have not been able to examine that earth quite free from yttria. On adding yttria to a bead with zirconia and a little uranic oxide, and gently flaming it in the oxidising flame, the uranic oxide combines with the yttria and rises to the surface as an orange-coloured scum, which has a great tendency to collect on the platinum wire; and, if sufficient yttria was added, the crystallised borate of zirconia is left in the interior almost colourless, and so free from uranic oxide that no absorption-bands can be seen in the spectrum. We may take advantage of this circumstance to detect yttria in small quantities of compound minerals like Gadolinite and Fergusonite; and I may here say that, by combining such means with the observation of the spectra of the transparent, or crystalline beads, and of the form of the crystals when slowly deposited, with or without the addition of suitable reagents\*, we may often detect twice as many constituents in minerals as could be accomplished by the ordinary methods of blowpipe chemistry—an advantage which I am sure will be appreciated by those engaged in the study of rocks, when it is often so important to obtain satisfactory results with small quantities of material. I have also found these methods of great practical use in examining small residues in the qualitative analysis of minerals, and have thus unexpectedly discovered small quantities of comparatively rare elements.

I have tried the effect of many other substances along with zirconia and the oxides of uranium, and find that most of them have no sensible influence, unless they are present in considerable relative quantity. The most striking effect is that of oxide of tin, which causes the two absorption-bands in the yellow and yellow end of the green in the spectrum of the uranous oxide compound to be nearly equally dark; whereas, without the oxide of tin, that in the yellow is comparatively faint. This is

another illustration of the manner in which certain substances having no special action on light influence by their presence the properties of another. The oxides of uranium are unusually sensitive to such actions, and thus not only lend themselves to us as blowpipe reagents, but also seem more than any others to afford the means of explaining the relation between the physical conditions of compounds and their action on light.

The only compound of zirconia with any other oxide to which I need now draw attention is that with chromic oxide, as deposited from a borax blowpipe bead. When treated in the deoxidising flame, and when cold, the very pale green bead gently re-heated, this compound crystallises out so as to give a fine red-pink colour by transmitted light, even when so little chromium is present that the glassy bead is scarcely at all green. If too strongly heated, the pink tint is lost. This compound is of interest in connection with the colour of rubies and other minerals coloured red by chromic oxide. To others, like the emerald, it communicates a green colour, and, on the whole, it acts on light in such a variable manner, according to the presence of other substances, that the spectra may be made use of as a means of identifying particular minerals, though they do not present anything like such striking anomalies as those met with in the compounds of zirconia with the oxides of uranium.

## ON CHLORAL HYDRATE.

By Dr. MACVICAR, Moffat, N.B.

THE physiological interest which attaches to this substance at the present moment induces me to present it as it presents itself in the system of molecular morphology, since I find that this may be done (though, of course, not very well) by the use of such types as are already in the hands of the printer as representatives of the forms of the elements involved.

As to the laws of chemical union and decomposition which are here referred to, or, indeed, which are ever admitted in the molecular nature which I advocate, they are all included in the law of symmetry, culminating in sphericity, towards which the first step usually is the union of dissimilars, when they come into the same neighbourhood.

It is only necessary to add (since no printer's type in use can show it) that the atom of hydrogen is the simplest structure possible into which equal and similar elements of matter or force can be built up so that it shall be truly symmetrical in relation to the sphere—that is, shall have two poles which are similar to each other, and an equator lying evenly between them. It, therefore, consists of five material units—two for the two poles, and three for the equator (for no smaller number than three can determine a plane). As to its form (that is, the form of the nucleus, for, as to the ethereal atmospheres of all atoms, they are universally spheroidal or spherical), supposing it viewed in reference to the lines of resultant force which join the five constituent forces in the angles, and so give edges to the form, we may say that it is doubly trachar or lance-shaped. The limit of its atomicity is 5. It may possibly carry atoms of some other substance, single or multiple, piled one on each of its two poles and three on its equator, five in all, but no more.

Its symbol, as a chemical agent, may be represented by three dots in a horizontal line, to represent its equatorial atomicity, as, also, other two, one above and another below, to represent its polar atomicity.



Hydrogen: its atomicity = 5.

But, for convenience, we may take to stand for it merely

\* See my paper, *Monthly Microscopical Journal*, vol. i., p. 349.



a printer's dash or dagger, the former of which may represent unity, also its atomic weight on the usual scale.

Hydrogen: its usual symbol.

For oxygen, we may take the figure 8, laid horizontally, and with an uniformly-broad face. Since the atom of oxygen comes out in shape a double concave lens, like a blood-disc or life-buoy, the cypher that has been named has some resemblance to its vertical section through the centre. It is also the atomic weight of a single atom on the usual scale, the law of sphericity requiring that these atoms, when in the free state, shall go in couples,

Oxygen gas.

the atomic weight of each 16 when  $H = 1$ .

Moisture.

The atom of carbon comes out a doubly-convex lens, fitting that of oxygen, as in an achromatic arrangement of lenses; it may, therefore, be represented by a narrow letter O. As in the case of oxygen, and for the same reason, single atoms of carbon tend, also, to go in couples;

A coupled atom of carbon.

but it is not possible to use the atomic weight 6 or 12 as its symbol in diagram-formulæ.

Add to these a longer letter of the same kind, to represent chlorine, and we have symbols sufficient for our present purpose.

Chlorine.

Carbon is first given to nature as the hydrocarbon,  $HCH=CH_2$ , a lengthened form of which every two

Nascent marsh gas.

under the law of sphericity unite in couples, constructing thereby a most exquisitely-spherical and finely-differentiated structure, viz.,  $CHC=C_2H_4$  = marsh gas.

Mature marsh gas.

The genetic atomicity of a coupled atom of carbon is, therefore, 4, in reference to hydrogen; and marsh gas is the perfect hydrocarbon. It is indestructible, if the temperature of its genesis be respected, and is most fit for existing in the æriform state above.

But nature detains it below, by loading, during vegetation, each of the three hydrogen-arms of the equator with an atom of carbon. And this may be applied to the axial atom in so many different ways that the formula  $CH(HC)_3C=C_5H_4$  will represent many substances of different properties. Of this element, the smallest dense

The essential-oil element.

molecule must be the tetratom, giving, as its formula,  $4 \times (C_5H_4) = C_{20}H_{16}$ , which is the chemical formula of non-oxygenated essential oils.

In regions of vegetable nature, where free carbon prevails still more, the retained hydrogen is made to go still farther, and one essential-oil element is made to yield four alkaloid elements—that is, elements in which each single atom of hydrogen is an axis loaded with five of carbon, thus saturating its atomicity.

The alkaloid element.

Unhappily, the load of carbon here is so great that this structure cannot be raised, by the chemist, into the æriform state and sublimed. It appears to him merely in a carbonaceous residuum containing hydrogen.

But when one atom of hydrogen more is added to either pole, the atoms can ascend in couples and be sublimed, their first dense molecules being the tetratom, giving  $4 \times (C_5H_2) = C_{20}H_8$ , which is the usual formula of naphthaline. Respecting this substance it is impossible to say to what valuable account the ingenious chemist may yet turn it for enhancing the enjoyment of life and for the relief of suffering.

The naphthaline element.

Returning now to marsh gas, with which we set out, it is to be considered that it may be loaded with carbon on the poles, as well as on the equator. Thus, in dry and hot regions, there may be on each pole a coupled, instead of a single atom of carbon, giving  $C_2H_4C_2=C_4H_4$  = olefiant gas.

Olefiant gas.

And in moist and cool regions, there may be an atom of simple hydrate of carbon,  $CHO$ —that which we obtain from the breaking up of an atom of sugar,  $C_{12}H_{12}O_{12}$ —and which we may call the saccharine element, which is trimorphous.

The saccharine element.

Place one of these saccharine elements—say that in the middle diagram—upon the poles of one atom of marsh gas and we obtain—

$HCOCHCOCH = C_4H_6O_2$  = Alcohol.

Alcohol.

Its three forms may be represented in our figurate formulæ. The chemical formula of all the three is, of course, the same:—

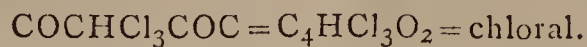
Alcohol  $C_4H_6O_2$ .

And this, we see, must be a very quick substance, its poles being capable of any one or other of these different structures, according to the conditions of its existence.

Under the law of sphericity, its axis is, however, too long; it is ready to lose something from its poles, and to receive expansion of its equator. Let chlorine, then, be let in upon it, so as not to disorganise it, but to improve its form, and we may expect that two atoms of the halogen will carry off the two atoms of hydrogen from the poles, as hydrochloric acid, thus shortening the axis, which was the first thing required by the law of symmetry (sphericity), and, afterwards carry off the three atoms of hydrogen now constituting the too feeble equatorial region,



and leave three of chlorine in their stead. The atom of alcohol will thus be transformed into—



Cl loral.

But this structure is greatly in want both of hydrogen and of oxygen; for the atomicity of a single atom of carbon is 2, in reference to oxygen, as well as hydrogen; and here there are only 2 of oxygen and 1 of hydrogen for 4 of carbon. Since, then, the law of symmetry allows it, we may expect that, on access being granted to moisture, the terminal atoms of carbon on the poles will resume their original condition of saccharines, and we shall have—



Chloral hydrate.

Now, as the poles (the region of chemical activity) here are saccharines, as in alcohol, there seems no reason to apprehend that this substance, so long as it keeps together in the living body, will be more poisonous than alcohol, though it must be more powerful. As to where it will break up when it is obliged to do so, this will depend on the process by which it was made (for every substance, when decomposing, other things being equal, tends to reproduce its original constituents) and on its surroundings. But, viewed in reference to its own structure, it may be regarded as an atom of chloroform,  $\text{C}_2\text{HCl}_3$ ,



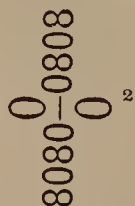
Chloroform.

capped on both poles by fully-oxidised saccharines—that is, by the formic element,  $\text{CHO}_2$ , the couple of which gives  $\text{C}_2\text{H}_2\text{O}_4$ , or  $\text{C}_2\text{HO}_3\cdot\text{HO}$ =formic acid.



The formic element.

When chloral hydrate then meets with matter more powerfully alkaline than its own body (which is an atom of chloroform), the polar elements may be expected to go off, thus exposing an atom of chloroform. Suppose they were to go off as saccharines, they would do no harm, nor would the dioxide of chloroform that remained probably be so dangerous, or effective, in causing sleep ("the sister of death") as the chloroform itself. But formic acid, if by any mistake it should get free, might prove a very disorganising agent. But would not all danger from the breaking up of the polar matter be avoided, if, for chloral hydrate, trichloroacetic acid could be substituted,



Trichloroacetic acid.

for then there would be given off only dioxide of carbon, which is perfectly harmless and might even be useful in assisting the hypnotic action.

## ON ORGANIC MATTER IN THE AIR.\*

By Dr. R. ANGUS SMITH, F.R.S., &amp;c.

(Concluded from p. 65).

AFTER these opinions and the detail of many facts, one is mentioned which was the culminating point of the enquiry, and has led to a mode of collecting the organic particles of air, which I may call established. This word established is used because the experiment has been done by others. It is given in these few but plain words:—"The air of cow-houses and stables is to be recognised as containing more particles than the air of the street in which my laboratory is, and of the room in which I sit, and that it contains minute bodies, *which sometimes move, if not at first, yet after a time, even if the bottle has not been opened in the interval.* There is found, in reality, a considerable mass of debris, with hairs, or fine fine fibres, which even the eye, or, at least, a good pocket-lens, can detect. After making about two-dozen trials, we have not been able to obtain it otherwise. Even in the quiet office at the laboratory, there seemed some indications."

"I found similar indications in a cow-house, with healthy cows. So I do not pretend to have distinguished the poison of cattle plague in these forms; but it is clear that, where these exist, there may be room for any ferment or fomites of disease; and I do not doubt that one class is the poison itself in its earliest stage. It would be interesting to develop it farther."

I do not detail the examination made of the condensed air brought from a cow-house by Mr. Crookes; nor do I detail the examination of the cotton through which Mr. Crookes had passed the air; nor the glycerine surfaces exposed to the air of cow-houses, which, also, was done by Mr. Crookes. My object at present is, not to give a history, but a few of the prominent points, so far as elates solely to my own part.

These experiments were repeated on air in Manchester. A paper was read, on March 30th, 1868, to the Literary and Philosophical Society, Manchester, Dr. Schunck in the chair. To quote a part:—

"Lately, I tried the same plan on a larger scale. A bottle of the capacity of 4.99 c.c. was filled with air, and shaken with water. The bottle was again filled, and shaken with the same water; and this was repeated 500 times, nearly equal to 2½ millions c.c., or 2.495 litres. As this could not be done in a short time, there was considerable variety of weather, but chiefly dry, with a westerly wind. The operation was conducted behind my laboratory, in the neighbourhood of places not very clear, it is true, but from which the wind was blowing to all parts of the town. I did not observe any dust blowing; but, if there were dust, it was such as we may be called on to breathe. The liquid was clouded, and the unaided eye could perceive that particles very light were floating. When examined by a microscope, the scene was varied in a very high degree—there was evidently organic life. I thought it better to carry the whole to Mr. Dancer, and to leave him to do the rest, as my knowledge of microscopic forms is so trifling, compared to his."

Having for years, therefore, convinced myself of these results, I took the air washings to Mr. Dancer, of Manchester, whose experience in microscopic objects is so great that I was certain to be corrected, if I erred; and, if I did not err, I should be taught more. His examination is very beautiful; and it shows, not only organic substances, but very many in quality, and inconceivably many as to quantity. The whole cannot be quoted; but the following will suffice:—

"The water was first examined with a power of 50 diameters only, for the purpose of getting a general knowledge of its contents. Afterwards, magnifying powers varying from 120 to 1,600 diameters were employed.

\* Read before the Manchester Literary and Philosophical Society, Jan. 25th, 1870.



"During the first observations, few living organisms were noticed; but, as it afterwards proved, the germs of plant and animal life (probably in a dormant condition) were present.

"1. Fungoid Matter.—Spores, or sporidiæ, appeared in numbers; and, to ascertain as nearly as possible the numerical proportion of these minute bodies in a single drop of the fluid, the contents of the bottle were well shaken; and then one drop was taken up with a pipette; this was spread out, by compression, to a circle  $\frac{1}{2}$  an inch in diameter. A magnifying power was then employed which gave a field of view of an area exactly 1-100th of an inch in diameter; and it was found that more than 100 spores were contained in this space. Consequently, the average number of spores in a single drop would be 250,000.

"On the third day, a number of ciliated zoospores were observed moving freely among the sporidiæ.

"Some of this formed a very interesting object, with a high power; and the greater portion exhibited what is called pitted structure. The larger particles of this had evidently been partially burnt, and quite brown in colour, and were from coniferous plants, showing with great distinctness the broad marginal bands surrounding the pits. Others had reticulations small in diameter. They reminded me of perforated particles so abundant in some kinds of coal.

"Along with these reticulated objects were fragments of vegetation resembling, in structure, hay, and straw, and hay seeds, and some extremely thin and transparent tissue showing no structure.

"A few hairs of leaves of plants and fibres, similar in appearance to flax, were seen; and, as might have been expected in this city, cotton filaments, some white, others coloured, were numerous, red and blue being the predominant colours. A few granules of starch, seen by the aid of the polariscope, and several long elliptical bodies, similar to the pollen of the lily, were noticed. After this dust from the atmosphere had been kept quiet for three or four days, animalculæ made their appearance in considerable numbers, the monads being the most numerous. Amongst these were noticed some comparatively large specimens of *Paramecium aurelia*, in company with some very active *Rotiferæ*; but, after a few days, the animal life rapidly decreased, and in twelve days no animalculæ could be detected.

"For the purpose of obtaining a rough approximation of the number of spores or germs of organic matter contained in the fluid received from Dr. Smith, I measured a quantity by the pipette, and found it contained 150 drops of the size used in each examination. Now, I have previously stated that, in each drop, there were about 250,000 of these spores; and, as there were 150 drops, the sum reaches the startling number of  $37\frac{1}{2}$  millions."

After these examples, the first being twenty-four years earlier than the last, I need not add that my certain knowledge is that particles both organic and inorganic are found in air.

Further, that some of the organic particles are organised.

Lime, soda, sulphates, and chlorides have been mentioned in another paper as being found, coal-ash and, of course, carbon, and to some extent the amount measured. In railway-carriages, we even breathe rolled plates of metallic iron which are large enough to be seen by the naked eye.

Some of the most difficult particles to remove are those of coal-smoke; they are oily or tarry, or both. These are instances of organic and not organised particles.

For two years I have been endeavouring to measure with certainty the amount of nitrogen in the organic matter, separating it from the inorganic. Some of the results are in the last "Report of the Proceedings under the Alkali Act," and have been pretty extensively published. Other results are soon to be published.

I have not yet spoken of my work, "On the Air of

Mines," where drawings of the particles of solid matter are given (in a long report published by the Mines Commission in 1864), because the air was from exceptional places. Still, similar results are got above ground. In the small tubes containing air from the mines and solids, I was able to detect very distinctly organic matter, and to measure the ammonia.

Still, the best proofs are in the sight of actual forms and the moving objects. In finding these with many accessories, I consider their existence in the air of such places as were tried proved beyond all doubt, also long ago proved. We now require good microscopists to examine the individual forms, and to find if every disease has one peculiar to itself, as Mr. Bailey finds every class of plants has its own peculiar pollen. That is probably the next most prolific field for those who desire something more on the subject.

We must not be panic-stricken because of these forms. Some are hurtful; but it may be that others are required for the maintenance of healthy animal life of the highest order, exactly as in vegetable fermentation. We must purify the air within the limits of natural intention, and be careful that we do not overstep its boundaries.

## NOTICES OF BOOKS.

*Acetopathy, or the Application of Medical Chemistry to Acute and Chronic Diseases.* By FRANCIS COUTTS. Edinburgh: Bell and Bradfute; John Menzies and Co. 1870.

THE author of this pamphlet makes the following assertion:—"I have diligently studied medical chemistry for the past twenty years, and am happy to be able to announce my discovery of an agent applicable to almost every disease, and which is based on purely chemical principles. That agent is acetic acid."

After a perusal of this quotation, our readers will surely agree with us in thinking that any critical remarks of ours would be superfluous. We need only add that the *proper acid* to use is that tested by the author, the price of which is two shillings per quart bottle, and carriage!

*Notes for Students in Chemistry; being a Syllabus of Chemistry and Practical Chemistry.* By ALBERT J. BERNAYS, Ph.D., F.C.S., Professor of Chemistry and Practical Chemistry at St. Thomas's Hospital, London. Fifth Edition. 1870. Churchill.

WE are glad to welcome a new edition of this little book. It has been considerably extended, and, as far as we have examined it, it appears to be remarkably accurate. Every chemist who takes it up will be struck with the vast mass of information which the author has condensed into a few small pages. The book really contains the essence of a bulky manual of chemistry. To students preparing for examination it must be invaluable.

## CORRESPONDENCE.

### SPECTRUM OF THE BESSEMER FLAME.

To the Editor of the Chemical News.

SIR,—In the last number of the CHEMICAL NEWS there is an inquiry respecting the application of spectrum analysis to the Bessemer process of making steel, to which I am able to give a tolerably definite reply. I have not myself been called upon to use it practically, but have had frequent opportunities for examining the flame and of hearing the results of the great experience in the manufacture of the steel at the works of Sir John Brown and Co., from my friend Mr. W. Bragge, who was the first to



suggest its application, and employed Professor Roscoe to make the necessary observations. Though a well experienced person can determine the time when the blast should cease, from the general colour of the flame, yet I am informed that a direct-vision spectroscope is found to be of great value, and is often employed.

According to my own observations, the flame at first gives a continuous spectrum without bright or dark lines, but in a while the sodium line appears, and afterwards several bright red, green, and other lines. There are also developed dark lines, as if from absorption, which becomes more and more distinct, and then more and more faint; and when the spectrum is just free from these dark lines the blowing should cease. I am informed that there are certain special lines which should be carefully observed, but I am unable to describe them definitely. As far as I have been able to judge, the spectrum method would very much assist a comparatively inexperienced observer, but I am by no means persuaded that it would be sure to give better results than those attainable by experience from the general colour of the flame, as seen by the naked eye; though, even in that case, it might be valuable for particular purposes. On adding the spiegel-eisen, dark bands are again seen, so as to give rise to a most remarkable spectrum.—I am, &c.,

H. C. SORBY.

Broomfield, Sheffield.  
February 14, 1870.

#### SPECTRUM OF THE BESSEMER FLAME.

*To the Editor of the Chemical News.*

SIR,—Your correspondent "A. B." will find reliable information on the application of the spectroscope to this process in Roscoe's "Spectrum Analysis," p. 107. The workmen invariably tell the proper time to stop the blast by a change in the appearance of the flame. Although I have watched the process very many times, I was never able to determine the precise point with any exactitude from the appearance of the flame to the naked eye, but with the spectroscope it is easy to determine the point with the utmost exactitude. The temperature of the flame steadily increases from the commencement of the blow until the blast is stopped. About six or eight minutes after the blast has been turned on, a group of red lines makes its appearance; this group is characteristic of carbon and increases in brightness until the carbon has been all burnt out of the iron, when it suddenly disappears.

It is thus extremely easy by watching this group to determine the exact point at which the blast should be stopped, and when watching the flame with the spectroscope I found that the time during which the blast was continued, under the direction of the manager, often differed, sometimes by as much as eight or ten seconds from the proper time as tested by the spectroscope, and by observing whether the charge had been "underblown" or "overblown," I was able uniformly to predict the quality of the steel. Those engaged in the process say that the spectroscope is useless, that it is of no consequence, that the process requires to be watched by a practised eye, and that they prefer to make steel of various qualities to be afterwards sorted than to make steel always of one quality. The experiments which I carried out on this subject at Crewe gave extremely interesting results, and I have no doubt that valuable information as to the change which takes place might be obtained by a further spectroscopic examination of the flame.—I am, &c.,

W. MARSHALL WATTS.

Manchester Grammar School.

#### SPECTRUM OF THE BESSEMER FLAME.

*To the Editor of the Chemical News.*

SIR,—In answer to your correspondent "A. B.," I can assure him that the spectroscope is quite capable of indi-

cating the period of "blowing" in the Bessemer process.

By examining the flame through certain coloured glasses, the changes occurring in it can be more easily determined, however. Two blue glasses with a dark yellow glass between give the best combination, and can be used with safety by the most inexperienced, as its indications are so marked and unmistakeable.

For further information on this subject I refer "A. B." to a paper I read before the chemical section of the Philosophical Society of Glasgow, "On the Examination of the Flame of the Bessemer Converter," which was published in the CHEMICAL NEWS of April 9, 1869, or he can have the paper in the form of a pamphlet by sending me his address,—I am, &c.,

THOMAS ROWAN.

Laboratory, 42, Bath Street, Glasgow.  
February 14, 1870.

#### BROWN'S ACTIVE MOLECULES.

*To the Editor of the Chemical News.*

SIR,—Will you allow me to suggest that if Professor Jevons examines the interesting phenomena brought by him before the Manchester Microscopical Society, and reported in your last number, on the principle of the surface tension of liquids, he will find the clue he is in search of.—I am, &c.,

C. TOMLINSON.

Highgate, N., Feb. 14, 1870.

#### TRIVALENT ELEMENTS.

*To the Editor of the Chemical News.*

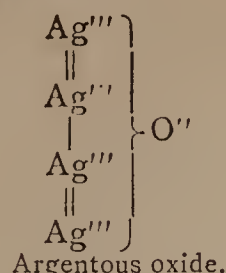
SIR,—In the CHEMICAL NEWS (vol. xx., p. 293), Mr. J. A. Wanklyn brings forward a new theory of the equivalency of sodium. Sodium has generally been regarded as a monad element, which degree of chemical force it exhibits in most of its salts; but, when we arrive at the so-called double salts (the chloro-platinates and the chloriodides, for instance), this monovalency of sodium is extremely vague.

But it must be remembered that shifting the equivalency of one element is a difficult process; for we know that potassium forms salts which are analogous in composition, if not in constitution, with those of sodium. Mr. Wanklyn objects to the hydrate of sodium being written as derived from water, on account of its caustic and extremely active properties; whilst the original type is, in itself, an admirable example of neutrality. Potassium hydrate, being analogous in composition, and possessing the same properties, it is quite rational to expect their constitution should be the same. The simple salts of the two metals can be thoroughly explained by the new theory, as Mr. Wanklyn himself shows in the case of sodium; but there is a point of much more importance than this and that—the explanation of the constitution of the double salts.

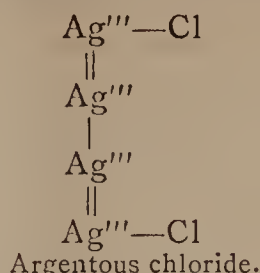
Although we have no combination of three monads with sodium or potassium, we have compounds in which sodium unites with an apparently triad element. Thallium, in certain respects, acts as an atom of potassium—it forms a hydrate, chloride, &c. This metal is classed as a triad; and why not sodium and potassium? Triad thallium unites with triad iodine. Triad potassium also unites with iodine.

Thus it may be seen that the alteration of equivalency as proposed by Wanklyn is of unlimited application as regards the now-denominated monad metals. Fownes's "Manual" (p. 360) contains a foot-note, to the effect that, if the formula for argentous oxide ( $\text{Ag}_2\text{O}$ ) is correct, oxygen must be a tetrad. And, on the preceding page, chlorine is made to act as a triad, in order that the constitution of argentous chloride may be explained; but, by classing silver as a triad, the difficulty vanishes—





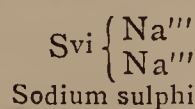
Argentous oxide.



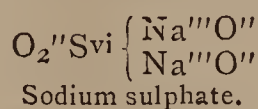
Argentous chloride.

But, to return to the compounds of sodium and potassium, Wanklyn gives sodium iodide as  $\text{INa}''' = \text{Na}''' \text{I}$ ; but the existence of iodine trichloride is sufficient evidence for the support of the trivalency of that element. If there exist, however, in the molecule *two atoms* of the haloid constituent, we must refer iodine back to the monad list; but, at present, it certainly appears as a combination of two triads— $\text{Na}''' \text{I}'''$ .

Extending the use of this polyvalency of sodium and the analogous metals, we may demonstrate the constitution of the alkaline sulphides, and their subsequent transformation into sulphates under the influence of oxidising agents, sulphur appearing in its highest degree of chemical force—

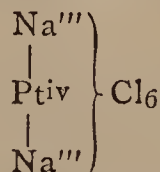


Sodium sulphide.



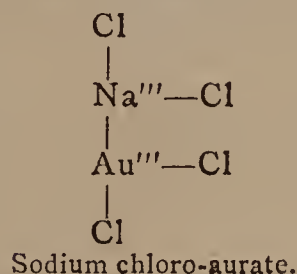
Sodium sulphate.

These formulæ also extend to the potassium and silver salts. But difficulties soon arise; for, by giving to potassium or sodium chloroplatinate the formula—

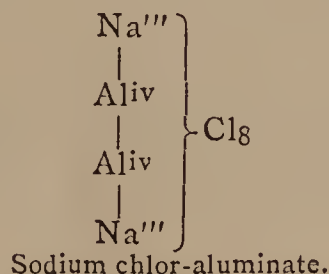


we must ignore the existence of the hydrogen salt, unless we give hydrogen also a triadic signification.

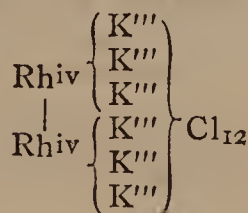
The following formulæ will, perhaps, give an idea of the so-called double salts:—



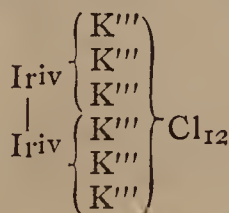
Sodium chloro-aurate.



Sodium chlor-aluminate.



Potassium chlor-rhodiate.



Potassium chlor-iridite.

The above formulæ will show that Wanklyn's views admit of much extension; being in the same isomorphous group as thallium, and acting as that element in all but the thallic salts, sodium, potassium, and silver, although their poly-haloid combinations have not yet been discovered, are with all probability trivalent elements.—I am, &c.,

GEORGE E. DAVIS.

Eton, Feb. 7, 1870.

## REACTIONS OF DISULPHIDE OF CARBON WITH BARIC AND CALCIC HYDRATES.

To the Editor of the Chemical News.

SIR,—With reference to a letter on the above subject in your last number from Mr. H. Matthews, I have several times observed a reaction between calcic hydrate and carbonic disulphide, which I have not seen mentioned anywhere, and which you may, perhaps, think worth recording.

Instead of using a solution of lime in this reaction, if

milk of lime be employed, and if this be agitated with carbonic disulphide for a short time and then allowed to stand, in the course of twenty-four hours bright orange-red coloured needles will begin to make their appearance in all parts of the sediment. They slowly spread and increase in number and size and in a month or more will have accumulated in considerable quantities.

Not having analysed this product, I am unable to say whether it consists of calcic sulphide or of calcic sulpho-carbonate.—I am, &c.,

J. GULSON BURGESS.

Leicester, Feb. 9, 1870.

## MISCELLANEOUS.

**Chemistry in the House of Commons.**—We are glad to find that Mr. U. J. Kay-Shuttleworth has been elected Member of Parliament for Hastings. Mr. Shuttleworth possesses a thorough knowledge of chemistry, and is the author of a valuable text-book for students. He will, we are sure, prove a warm advocate of technical education, and at no time has it been more important to send scientific men to Parliament than the present, when the great question of education is to be brought forward, and, we hope, settled in a manner satisfactory to all classes.

**Preparation of Alizarine from Madder.**—M. Schützenberger.—Take some yards' length of genuine Turkey red dyed cotton which has been cleansed (*avivé*), cut it up in suitable pieces, best ribbon-like shreds; pour upon it a quantity of strong alcohol (85 per cent strength) well acidified by means of concentrated sulphuric acid, and digest for some days without application of heat; pour off the liquid from the rags and saturate accurately with ammonia (excess is carefully to be avoided), when, by a mixture of ammonia and sulphate of alumina, alumina is thrown down. This is separated by filtration, and the filter washed with some alcohol; the liquid is next concentrated by evaporation on a water-bath, and afterwards water is added, causing a precipitation of mixed fatty and colouring matter; this precipitate is thoroughly dried, and, when dry, exhausted with rectified sulphide of carbon, which dissolves fatty matter, leaving almost perfectly pure alizarine, which, however, if desired, may be sublimed by being placed in a porcelain capsule, and heated on a sand-bath to about 250°. This method yields a pure substance, and, as regards quantity, a very satisfactory result, while the operation is far easier than when either madder or its alcoholic extracts are employed.

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus des Séances de l'Académie des Sciences, February 6, 1870.

This number opens with a brief communication on a subject which, though not belonging to chemistry, we cannot refrain from quoting, viz.:—

**Extraordinary Fall of Snow at Collioure, Pyrénées Orientales, France.**—Ch. Naudin.—Collioure is situated on the Mediterranean, in latitude 42° 32' N. The author states that the prevailing temperature, up to the 17th of January, had, as usual, ranged from +11° to +17° C.; it then fell gradually, and on the 21st ult., while at -0.8°, a fall of snow commenced, which continued for 44 consecutive hours. A few of the oldest inhabitants remember a similar phenomenon taking place in the year 1804; very few, however, have ever witnessed such a remarkable occurrence. The average depth of the snow amounted, in open spaces, to from 80 to 120 centims., but in some parts it accumulated to a depth of nearly 1.5 metres (fully 5 ft.); the temperature at this time was about -1°. Among the very noticeable points, the author speaks of the palm trees, which were literally flattened down, as plants are in an herbarium; but, curiously



enough, notwithstanding some of them have been for ten or twelve days in a mass of ice and snow, they have suffered very little, compared with the orange, lemon, and olive trees, most of which are destroyed. The author, therefore, calls particular attention to this fact, because geologists have drawn conclusions as to climate from the discovery of palm trees in the miocene strata; and it appears to him that the facts observed at Collioure prove (though isolated) that these plants might actually stand a severer winter climate than is usually believed, while they also point out that the causes of the death of plants in winter are more complex, and not simply due to a certain degree of cold only.

**Proof of the Destruction of the Chemical Type when Substitution Takes Place.**—E. J. Maumené.—This lengthy paper is chiefly devoted to prove a peculiar theory which the author holds. The paper is too lengthy for useful abstraction.

**On Thermo-Electricity.**—J. Delaurier.—The author says—"I have proved the existence of metals and other bodies which are by themselves thermo-electric, and these I call active bodies. The production of electricity is not due to the two metals which are soldered or joined together, since a non-active metal is only a carrier of the electricity developed by heat in the active body. The cause and direction of the current depend chiefly upon the molecular structure of the active body. Heat is converted into electricity by preference in those substances which are relatively better conductors of electricity than of heat. There exist solid bodies which possess the property of yielding as much electricity as hydro-electric elements; among these, tellurium and iron pyrites stand foremost."

**Observations on the Zodiacal Light and Aurora Borealis at Munster, Westphalia (Prussia).**—M. Heis.

**Simplification of the Construction of Holtz's Electrical Machine, and Determination of the Relation between the Dynamical Work Done and the Quantity of Electricity Produced.**—E. Bouchotte.—A lengthy memoir on this subject.

**Heat Evolved when Silicium Combines with Chlorine and with Oxygen.**—L. Troost and P. Hautefeuille.—This paper is a continuation of one on the same subject by the same authors. In this very lengthy memoir, amorphous silicium is treated. The heat disengaged by the combination of 1 grm. of this amorphous body with oxygen is 7830 units; with chlorine, 5630. When 1 grm. of chloride of silicium reacts upon 140 times its weight of water, it is 2915; the heat disengaged when 1 grm. of amorphous silicium is converted into crystallised silicium is 290 units of heat. When taken by equivalents, these quantities become, respectively:—

	For Si=14.	For Si=21.
With oxygen .. .. .	109,620	164,430
With chlorine.. .. .	78,820	118,230
When the chloride reacts upon 140 times its weight of water.. .. .	40,820	61,220
When conversion from amorphous to crys- tallised .. .. .	4,060	6,090

There is added to this paper a very interesting, but, unfortunately, too lengthy discussion on certain phenomena observed in the Bessemer and other metallurgical processes of iron manufacture.

**New Method of Synthesis of Organic Acids.**—M. Berthelot.—Reserved for full translation.

**Simultaneous Formation of Isomeric Substances in Definite Proportions.**—A. Rosenstiehl.—The author refers to his former researches on this subject, and treats, in this memoir, a rather intricate matter, the main gist of which is, that not (as has been stated by several chemists) three, but only two, isomeric toluens are formed when nitric acid acts upon the toluen obtained from coal-tar.

**Nature and Origin of the Blood Globules.**—MM. A. Béchamp and A. Estor.

**Present State of the Volcano of Santorin.**—M. Gorceix.

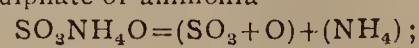
**Presentation of Valuable Manuscripts.**—M. Bontemps.—This gentleman has handed over to the Academy the very valuable collection of manuscripts left by the late Prof. Charles, whose name is connected with the first experiments of the use of hydrogen, in the year 1783, for the purpose of filling air balloons. The deceased was, in his day, a physicist of celebrity; and his lectures on experimental natural philosophy are well known. The Academy has accepted the offer made by M. Bontemps, who had obtained these papers in consequence of his father having been Prof. Charles's friend and one of the executors of his will.

#### *Journal de Pharmacie et de Chimie, January, 1870.*

This number contains the following original papers relating to chemistry:—

**Transformation of the Hydrate of Chloral into Chloroform in the Animal Body.**—M. Personne.—A physiologico-chemical essay.

**Researches on the Electrolysis of Organic Alkalies, or Alkaloids.**—M. Bourgoin.—The author, in order to illustrate his subject, begins by explaining the action of an electric current upon perfectly pure and neutral sulphate of ammonia—



Positive Negative  
electrode. electrode.

and next at the positive electrode,  $(\text{SO}_3 + \text{O}) + 3\text{HO} = \text{SO}_3\text{HO} + \text{O}$ ,

and at the negative electrode,  $\text{NH}_4 = \text{NH}_3 + \text{H}$ . The author next describes, at length, a series of experiments made with neutral sulphate of atropine, the acid sulphate of atropine, neutral sulphate of brucine, the acid sulphate of brucine, and the neutral and acid sulphates of codeine and quinine. The conclusions to be drawn from these experiments may be summarised as follows:—The electric current decomposes the salts of alkaloids in the same manner as it acts upon sulphate of ammonia—that is to say, the basic element re-constructs the alkali at the negative electrode, and the rest of the elements of the salt is set free at the positive electrode. When the solution is acid (not readily so when it is neutral), the positive liquid assumes a colouration which is precisely the same as that which nitric acid yields, but is entirely independent of the formation of any nitrated compound. The gas given off at the positive electrode contains not only oxygen, but also carbonic acid and oxide of carbon, often in equal bulks. There are, beside these gases, various other products formed (especially ammoniacal compounds)—the result of the splitting up of the alkalies which are gradually burnt up by the action of the oxygen, which action is the more energetic the more acid the solution contains.

**Researches on Bromide of Potassium: its Best Preparation and Composition when Pure.**—M. Adrian.—This paper contains the results of analyses of ten samples of bromide of potassium, from which we condense the following points:—The quantity of water interposed (water of decrepitation) between the crystals varied from 4 to 0.5 per cent; the quantity of free, or carbonated alkali, not combined with the haloid, varied from 4 to 1.5 per cent; the quantity of iodide of potassium (contained only in three, out of the ten samples), varied from 2 to 0.5 per cent; the quantity of bromide of potassium varied from 91.60 to 62.80 per cent (average of 10 samples, 83.67 per cent); chloride of potassium varied from 3.5 to 30.07 per cent; sulphate of potassa varied from 0.90 to 3.30 per cent; while, of bromate of potassa, traces were present in all, and an appreciable quantity in one sample.

**On Mustard.**—M. Commaille.—A lengthy memoir, compiling what is known of the chemical constitution and properties of mustard, and its pharmaceutical uses.

#### *Annalen der Chemie und Pharmacie, January, 1870.*

This number contains the following original papers and memoirs:—

**On Fermentation, and on the Source of Muscular Force.**—Dr. Justus von Liebig.—This paper is the first instalment of a series to be continued. The section title to this memoir is "Alcoholic Fermentation;" we regret that it is not possible here to enter into any details of this memoir, which deserves full translation.

**Contribution to our Knowledge of the Bases Contained in Opium.**—M. Hesse.—After referring to the labours of M. Merk, and his own former researches on this subject, the author describes meconidine, lanthopine, and laudanine. Meconidine,  $\text{C}_{21}\text{H}_{23}\text{NO}_4$ , is a rather readily decomposable compound in the presence of strong acids, and especially when heat is simultaneously applied; this base yields salts with difficulty, and these compounds are very unstable. Laudanine is readily soluble in benzol and chloroform, also in boiling alcohol, but difficultly soluble in ether and alcohol when cold; this base, although tasteless by itself, yields, with acids, very bitter salts; fuses at 165°; formula,  $\text{C}_{20}\text{H}_{23}\text{NO}_3$ ; yields salts with acids, well-defined chemical compounds. Lanthopine,  $\text{C}_{23}\text{H}_{25}\text{NO}_4$ ; this substance is best soluble in chloroform, difficultly so in alcohol, ether, and benzol; it yields, with acids, salts. Thebenine,  $\text{C}_{19}\text{H}_{25}\text{ClO}_6$  (formula of the hydrochlorate of this base), is an amorphous substance, and rather prone to decomposition.

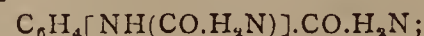
**Treatise on the Urea Compounds.**—M. Menshutkin.—First part: The Ureides. Section 1: Action of Cyanate of Potassa upon the Amido Acids, and the Derivatives therefrom.—Oxybenzuramic acid—



oxybenzoyl-urea—



oxybenzuramide—



anisuramic acid—



Space forbids us to quote more formulæ, with which the treatise abounds.

**On Dichlorobromohydrine, and its Decomposition by Hydrate of Baryta.**—M. Claus.—The main object of this paper is the vindication of the correctness of the author's labours on the subject, somewhat impugned by other labourers in the same field.

**Some of the Combinations of the Toluol Group.**—MM. Limpricht and Schwanert.—Second paper on this subject, treating chiefly of:—Oxytolidens,  $\text{C}_{14}\text{H}_{10}\text{O}_2$ , solid substances, readily soluble in ether and boiling alcohol, fusing at 172°, and subliming without decomposition; bromoxytoliden,  $\text{C}_{14}\text{H}_9\text{BrO}_2$ , an oily fluid; bibromoxytoliden,  $\text{C}_{14}\text{H}_8\text{Br}_2\text{O}_2$ , a solid substance, soluble in ether, sulphide of carbon, and boiling alcohol; chloroxytoliden,  $\text{C}_{14}\text{H}_9\text{ClO}_2$ , a solid crystalline body, soluble in ether, benzol, and boiling alcohol, also in glacial acetic acid, and fusing at 57°; trichloroxytoliden,  $\text{C}_{14}\text{H}_7\text{Cl}_3\text{O}_2$ , a solid body, fusing at 87°, and soluble in benzol, ether, hot alcohol, and hot glacial acetic acid; pentachloroxytoliden,  $\text{C}_{14}\text{H}_5\text{Cl}_5\text{O}_2$ , readily soluble in benzol and boiling glacial acetic acid, difficultly soluble in ether and alcohol, and fusing at about 189°.

**Preparation of Lepiden from Thionessal.**—M. Berlin.—The author heated thionessal with HCl and chlorate of potassa, and the purified product of this reaction was again heated in a sealed tube



with hydriodic acid, to  $140^{\circ}$ ; the resulting product gave, after purifying and re-crystallisation, lepiden,  $C_{25}H_{20}O$ .

*Bulletin de la Société d'Encouragement pour l'Industrie Nationale*, No. 204, December, 1869.

This number contains the following original papers relating to chemistry and allied sciences:—

We briefly call attention to two reports, the subjects of which, although not related to chemistry, deserve a passing notice:—

Report on a Printing Stenographic Apparatus Invented by M. Bryois.

Report on the Means of Saving Life in Cases of Fire in Dwelling-Houses and High Buildings.—M. Charrière.—This excellent report is illustrated with woodcuts, and deserves the attention of all whose dwelling-houses and places of abode are at some elevation above the level of the streets.

Alkaline Lakes of California.—M. Phillips.—It appears that a portion of California is very rich in mineral waters, and, moreover, contains large sheets of water, evidently occupying the craters of extinct volcanoes. The water of Lake Owen has a sp. gr. of 1.076, and contains 7128.24 grs. of solid matter to the gallon, consisting of 2942 grs. of chloride of sodium, 956 grs. of sulphate of soda, and 2914 grs. of carbonate of soda; while the rest is composed of sulphate and phosphate of potassa, silica, and traces of organic matter. On the banks of this lake, an incrustation occurs, of yellowish white colour; this substance gave, on analysis, in 100 parts—Chloride of sodium, 2.14; sulphate of soda, 3.10; carbonate of soda, 46.10; silica, 0.22; traces of potassa; and 48.44 of water and organic matter. The Kaysa, or borax lake, yields, daily, 3000 lbs. of crude borax, composed, in 100 parts, of—Dry biborate of soda, 51.85; water of crystallisation, 45.44; insoluble matter, 1.42; dry sulphate of soda, 0.06; chloride of sodium, 0.08; phosphate of soda, 1.15. The water of this lake has a sp. gr. of 1.0274, and contains, of the following substances, the quantities thereby quoted in grains to the imperial gallon:—Chloride of sodium, 1198.66; chloride of potassium, 9.92; iodide of magnesium, 0.22; bromide of magnesium, a trace; carbonate of soda, 578.65; biborate of soda, 281.48; phosphate of alumina, 3.52; sulphate of lime, traces; silica, 2.37; matters volatile at red heat, 238.66. All the salts are calculated in the anhydrous state. The mud of this lake contains large quantities of crystallised borax; at some short distance from this lake, a rich sulphur deposit is met with, which contains, also, a vein of cinnabar; both these minerals are now worked. The quantity of sulphur daily obtained amounts to some 7 tons' weight.

Mining, and some other Industries of Russia.—This empire contains 1043 gold mines, which, in 1866, produced 26.5 tons of pure gold; only 18 tons of silver were produced; the quantity of platinum was 1712 kilos.; and of copper, 4320 tons were obtained. The beet-root sugar works produced, in 1867, 70,000,000 kilos. of sugar; while, during the same period, 382,000 metrical quintals of tobacco were grown.

Official Instruction concerning the Keeping and Use of Nitroglycerine.—The Chief Inspector of Mines at Dortmund, Prussia, while sanctioning the use of this material for blasting purposes, has laid down excellent rules for its safe keeping and management, which deserve attention, and may be usefully applied wherever this explosive substance is employed.

*Jahrbuch der Kaiserlich-Königlichen Geologischen Reichsanstalt*, No. 3, 1869.

Among the record of the labours performed at the Chemical Laboratory of this Institution, we meet with a lengthy series of minute analyses of braunkohlen. Kaolin from Budweis—Silica, 48.6; alumina, 43.0; peroxide of iron and magnesia, a trace; water, 8.2. Fire-clay from Bihar (Hungary)—Silica, 60.3; alumina, 28.0; lime, 0.5; water, 10.5. Porcelain clay from Mahrenberg (Styria)—Silicate of alumina, 87.6; alumina soluble in HCl, 5.5; magnesia, 2.1; water, 4.6. Iron ore from the Josephthal iron ore quarries—Insoluble in HCl, chiefly quartz, 61.8; peroxide of iron, 30.5; lime, 8.0; magnesia, a trace; yield of metallic iron, 21.3 per cent. Crude carbonate of potassa from Czernowitz—Insoluble in water, 0.1; carbonate of potassa, 58.0; carbonate of soda, 2.1; sulphate of potassa, 14.2; chloride of potassium, 3.1; water, 23.2. The Director of this Laboratory, Dr. Karl Ritter von Hauer, states that the water was taken up hygroscopically.

*Les Mondes*, February 10, 1870.

This number opens with a lengthy paper on the—

Imperial Observatory.—M. Moigno.—The main gist and aim of this paper is a review of M. Le Verrier's career as Director of the Observatory, a situation from which that gentleman has been relieved by a recent imperial decree.

Artificial Construction of Mineral Springs.—M. Rouby.—There is a woodcut annexed to this paper which renders its proper understanding an easy matter. The affair is, however, simple enough, since the contrivance (applicable only in the country, and requiring, moreover, a hilly region) consists of a subterranean water-tight tank, covered on the top with divers layers of minerals, through which the rain-water is made to pass; and this, while trickling down, dissolves a portion of the mineral matters, and enters, thus charged therewith, the tank, from which an exit-pipe leads it to the place of consumption.

Solar Electricity.—M. Marco.

Syphon Pumps and Suction Syphon.—M. Lagillardais.—A good paper on applied hydrodynamics, illustrated by woodcuts.

Improved Photometer for taking Positive Carbon Proofs.—M. Marion.—Illustrated by a cut.

Labour of Children in Manufactories.—Dr. Decaisne.—An interesting account of a large establishment at Lyon.

*Annales de Chimie et de Physique*, December, 1869.

The only original paper contained in this number is a brief optico-physical description of a—

New Micrometer.—M. Soleil.—Not suitable for abstraction.

*Revue des Cours Scientifiques de la France et de l'Etranger*, No. 10 1870.

Contains nothing relating to chemistry or allied sciences.

February 12, 1870.

Banquet to Dr. A. W. Hofmann at Berlin.—The German Chemical Society, having elected Dr. Rammelsberg as their President for this year, have entertained their late President, Dr. A. W. Hofmann, at a splendid and sumptuous banquet, presided over by Prof. Magnus. Among the large number of guests, we name Dr. R. Virchow, Prof. Dove, Prof. Rose, Dr. du Bois Reymond, His Excellency the Right Hon. Mr. Bancroft, the United States Minister at Berlin, and a very large number of *savants* from Berlin and other parts of Germany. Many of the foreign members sent telegrams of felicitation, and among these the following was received from M. J. Dumas, Paris:—"Your festive meeting is heartily shared by all chemists of the world who admire and cherish you." Just before the meeting broke up, there was distributed a photo-lithograph representing Dr. Hofmann, under the emblem of Jupiter Ammon (typifying his researches on ammonium), with an aureola of aniline colours. A large number of toasts were heartily responded to; and an ode to aniline, composed for the occasion, caused general applause and great merriment.

*American Journal of Pharmacy*, January, 1870.

Among a great deal of strictly pharmaceutical matter, this number contains the following original papers relating to chemistry:—

Contribution to Our Knowledge of the Chemical Composition of Gelsemium Sempervirens.—Dr. Wormley.—The author made a series of experiments with the fluid extract of gelsemium, and has discovered therein a new organic acid and a new alkaloid—the former having been denominated gelseminic acid, and the latter gelseminine. The preparation and properties of these are described at very great length. In pure state, gelseminic acid is a colourless, odourless, nearly tasteless, solid crystallisable substance, sparingly soluble in water, more soluble in hot water, and freely soluble in ether and chloroform; the substance is a strong acid, completely neutralising bases, and forming salts, which, excepting those of the alkalies, are sparingly soluble in water. The following is a characteristic test for this acid:—When the acid, or any of its salts in solid state, are treated with a drop of strong nitric acid, the substance dissolves under a yellow colouration, to a yellow-reddish, or red solution; if to this be added excess of ammonia, it acquires a deep blood-red colour, which is permanent, at least for some hours. The 1-10,000th of a grain of the solid acid yields, with nitric acid, a well-marked yellow colouration, which assumes with ammonia distinctly a pale red hue. Gelseminine is, in pure state, a colourless, odourless solid, having an intensely bitter taste; it has strongly-basic properties, completely neutralising the most powerful acids; in free state, sparingly soluble in water, freely soluble in ether and chloroform. It is distinguished by the property of yielding, with concentrated sulphuric acid, a reddish brown colour, which, on being moderately heated, acquires a beautiful purple colour; this reaction is produced with even 1-100th of a grain of the alkaloid, or any of its colourless salts. Addition of bichromate of potassa to this acid solution produces no marked change. The alkaloid and the fluid extract are very poisonous substances. This paper contains a toxicological research, in consequence of a case of poisoning having accidentally taken place with the fluid extract of the *Gelsemium sempervirens*, which, we believe, is a native American plant.

Adirondack Mineral Springs.—Dr. Bell.—This spring exists near the Adirondack Mountains, in the state of New York. The water may be regarded as a saline chalybeate, with a considerable quantity of free carbonic acid; it is without smell and any very marked taste. One imperial gallon was found to contain the following substances, expressed in grains:—Sulphate of lime, 11.134; carbonate of lime, 18.543; carbonate of magnesia, 16.618; carbonate of iron, 5.040; carbonate of manganese, a trace; carbonate of potassa, 5.317; carbonate of soda, 5.135; carbonate of lithia, 0.023; chloride of sodium, 14.340; alumina, a trace; insoluble residue, 7.42; free carbonic acid, 67.3 cubic inches.

Naphthalene as a Protective against Moths and other Insects.—M. Markoe.—From the statements made by the author in this paper, it appears that the well and deservedly-known *savant*, Prof. Asa Gray, has thoroughly tested and obtained highly satisfactory results, conclusively proving that naphthalene may be advantageously

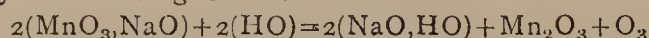


used in museums, herbariums, &c., instead of camphor, as a very effective protection against moths and other insects.

*The Journal of the Franklin Institute*, November, 1869.

This number contains the following original papers relating to chemistry and allied sciences:—

**Oxygen Manufactured on the Large Scale.**—Prof. Morton.—The works for this purpose are at New York, and consist of retort-houses, engine-rooms, store-house, pumps for compressing gas in cylinders, and a gas-holder of 26,000 cubic feet capacity. The process is carried on as follows:—About 700 lbs. of manganate of soda are placed in the retort and heated to the requisite degree; superheated steam from a boiler is then admitted for about ten minutes. 2 equivalents of the manganate of soda, and 2 of water, react upon each other, as indicated by the following formula:—



in other words, the water combines with the soda of the manganate, to form a hydrate of soda, the manganic acid is converted into sesquioxide of manganese, containing only half the proportion of oxygen, and the other half of the latter passes off in free state. At the conclusion of this part of the process, the steam is shut off, and the superheated air is admitted for about fifteen minutes whereupon the sesquioxide combines with more oxygen from the air, and is re-converted into manganic acid, which again combines with soda. The retorts in each furnace are charged with 700 lbs. of permanganate of soda, and by the consumption of 2 chaldrons of coke, and with the labour of three men, 25,000 cubic feet of oxygen are made per day. It is now sold at 5 cents (2½d.) per cubic foot, compressed in reservoirs up to a pressure of 250 lbs. to the square inch. The gas is of excellent quality and very pure.

**Spectrum of the Aurora Borealis and Zodiacal Light.**—M. Angström.

**Analysis of Native Phosphate of Lead from Chester County, Pa., U.S.**—Mr. Williams.—The author describes, at great length, his method of analysis, and quotes the following results:—(1) Mineral of dark olive-green colour contained, in 100 parts:—Phosphate of lead, 87.40; phosphate of lime ( $3\text{CaOPO}_4$ ), 0.37; phosphate of protoxide of iron, 1.74; chloride of lead, 9.79; fluoride of calcium, 0.34; matter insoluble in acid, 0.42. (2) Of a yellowish green shade, in 100 parts:—Phosphate of lead, 85.89; phosphate of lime, 2.64; phosphate of protoxide of iron, 0.62; chloride of lead, 9.41; fluoride of calcium, 0.67; insoluble matter, a trace. (3) Mineral of a darker colour than No. 2, in 100 parts:—Phosphate of lead, 87.01; phosphate of lime, a trace; phosphate of iron, 1.39; chloride of lead, 9.13; fluoride of calcium, 0.91; insoluble, a trace. A separate assay for silver was made, giving 0.0037 per cent, or about 1.1 ozs. to the ton of 2000 lbs.

**Native Gold from Venezuela.**—Mr. Williams.—It contained, in 100 parts:—Gold, 93.583; silver, 3.687; iron, 1.60; copper, 0.650. No platinum, or metals associated with it, were detected.

**Various Processes for Preserving Timber.**—Mr. Beer.—This paper is written by the author with the view to contradict and correct several statements made by Dr. Ott in a paper written by the latter on this subject, and published in this periodical.

**New Chemical Nomenclature.**—Dr. Ott.—This paper, a continuation of a former, contains much valuable information on the history of the nomenclature previous to Lavoisier's time.

**The United States' Cabinet of Practical Geology and Mining.**—Mr. Wilson.—From this paper, we learn that a cabinet, or collection rather, has been organised at Washington for the collection and preservation of a complete system of geological and mineralogical memorials of the whole extent of the great Republic. M. Roessler, educated at Vienna, and formerly in the Austrian geological service, has charge of this institution.

**Electricity Applied to Registering Vibrations.**—Mr. Cooley.

**Easy Rules for Astronomical Refraction.**—Mr. Lyman.

**Processes for Preserving Timber.**—Dr. Ott.—A continuation of a former paper. This part chiefly treats on what is called Heinemann's process of preservation, by means of forcing molten resin into timber the sap from which has been previously exhausted.

December, 1869.

**Separation of Animal from Vegetable Fibre.**—Mr. Stuart.—The author subjects rags, carpet cuttings, old carpets, and other waste material consisting of mixed fibres, to a solution consisting of 100 gallons of hot water, 100 lbs. of commercial sulphate of alumina, and 50 lbs. of common salt. In this solution, the material is kept boiling until the vegetable fibre is decomposed; the material is then well washed and dried, and scribbled, or carded.

**Electro-Plating with Iron.**—Mr. Clay uses a bath composed of ferrous sulphate combined with sulphate of ammonia, potassa, or soda.

**Tellurium Ores in the United States.**—M. Roessler.—The author states that a mineral named montanite, from the locality where it was found, is a tellurate of bismuth associated with pure telluride of bismuth; another variety contains sulphur in addition (5 per cent), and its formula is  $\text{BiS}_3 + 2\text{BiTe}_3$ . The montanite is a yellowish mineral, with waxy lustre, and contains, according to assay, £20,000 worth of gold to the ton of 2000 lbs. Tellurium minerals are (the author observes) very rarely met with, but, when found, contain generally much gold and silver, which are, however, excluded from native tellurium.

*Bayerisches Industrie und Gewerbeblatt*, September to December, 1869.

The greater portion of these numbers is occupied by the publication of laws and other official matters relating to Bavaria. Among these, we meet with very complete and well got up instructions for the inspectors of weights and measures, in consequence of the introduction of the decimal system. A large portion of these numbers is devoted to regulations relating to technical instruction, which is carried out to a very high degree in this kingdom.

**Application of Heat to Mechanical Labour.**—Dr. Linde.—A valuable contribution to the better utilisation of heat to be converted into mechanical force.

**Technical Application of Coke obtained from Peat.**—Dr. Vogel.

**The More Recently Discovered and Valuable Metallic Alloys.**—Dr. Fürtenbach.—This very lengthy paper is an excellent compilation on this subject.

## NOTES AND QUERIES.

**Colours and Pigments.**—Can any of your readers inform me of any, or the best, works treating on the manufacture of pigment colours, painters' colours, and paper printers' colours; also, what work is the best on the manufacture of blood and egg albumen.—A READER, Church, near Accrington.

**Distilling Tar.**—Can you refer me to any work that treats upon the process of distilling tar? I am in a place where I can procure 6 or 7 tons of tar from the gas works every week. There is a tar distiller not far from the town, but he will tell me nothing, even for money. I should like to know the process—how long it is boiled, what vitriol to put in, and how to separate the contents when the pitch is run off. I know that colours are made from it, as well as oil, ammonia, carbolic acid, &c.—A CHEMIST.

**Gutta-Percha Vessels for Chemical Uses.**—Erroneous views have been held and circulated concerning the durability of gutta-percha under the action of various reagents. We are ordinarily told that it is absolutely unacted upon by cold mineral acids, with the single exception of the sulphuric at 1.0 sp. gr. and upwards. This is far from being the case. There is, indeed, no immediate corrosion, or other rapid and striking change; but, in course of time, the surface becomes overspread with a thin buff-coloured layer, which may be easily rubbed off. This change extends gradually deeper and deeper, till the whole mass loses its coherence and splits in various directions. I have before me a number of jugs which have been used for nitric, chlorhydric, and dilute sulphuric acids, as, also, for solutions of stannous, stannic, and ferric salts, and which, in less than three years' service, have become quite worthless; on being sent for repairs to a dealer in such articles, they were returned with the remark that they "could not be mended, as they had been used for acids." I find that the disintegration in question can be very much retarded if the vessels are always rinsed in cold water immediately after being used.—J. W. SLATER.

## MEETINGS FOR THE WEEK.

MONDAY, 21st.—Medical, 8.

— London Institution, 4.

TUESDAY, 22nd.—Royal Institution, 3. Professor Humphry, "On the Architecture of the Human Body."

— Institution of Civil Engineers, 8.

— Ethnological, 8.

WEDNESDAY, 23rd.—Society of Arts, 8. Capt. Douglas Galton, C.B., "On Economy in the Use of Fuel for Domestic Purposes."

— Geological, 8.

THURSDAY, 24th.—Royal Institution, 3. Prof. Odling, "Chemistry of Vegetable Products."

— Royal, 8.30

— Zoological, 8.30

— Philosophical Club, 6.

FRIDAY, 25th.—Royal Institution, 8. Capt. Wilson, "Results of Ordnance Survey of Sinai."

— Quekett Microscopical Club, 8.

SATURDAY, 26th.—Royal Institution, 3. Mr. Max Müller, "On the Science of Religion."

## TO CORRESPONDENTS.

\* \* Vol. XX. of THE CHEMICAL NEWS, containing a copious index, is now ready, price 11s. 4d., by post, 11s. 10d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our office, or, if accompanied by a cloth case, for 1s. Subscribers wishing to complete their sets of volumes are requested to apply to the publisher, who will give them information respecting scarce numbers and volumes. Vol. xxi. commenced on January 7th, and will be complete in twenty-six numbers.

*An Old Subscriber* (Maryland, U.S.).—The address of Mr. Sicbe, the maker of the refrigerating machine, is Mason Street, Lambeth, London. *Engineering* of Nov. 27th, 1868, gives a description of the apparatus in use at Truman, Hanbury, and Co.'s Brewery.

George Gore, F.R.S., Professor Heaton, Professor Cameron, and H. N. Draper.—Received with thanks.



# THE CHEMICAL NEWS.

VOL. XXI. No. 535.

## ON THE TESTING OF PETROLEUM SPIRIT.

By F. CRACE CALVERT, F.R.S., F.C.S.

I HAVE read with much interest of late several papers on the Petroleum Act of 1868, and on the uncertainty of getting good results when testing the "flashing-point" of petroleum spirit, especially the papers published by Mr. Paul in the CHEMICAL NEWS and a pamphlet by Mr. Norman Tate, Liverpool, I therefore deemed it my duty to make a series of experiments, with the hope of throwing some light on the subject; the more so that the defect of the Act of 1868 is that no length of time is specified for raising the petroleum spirit from natural temperatures to its flashing-point. Thus the Act states:—

"The outer vessel shall be filled with cold or nearly cold water. A small flame shall be applied at the bottom of the outer vessel; and the thermometer shall be inserted into the oil so that the bulb shall be immersed about one-and-a-half inches beneath the surface."

What is understood by a "small flame?" appears to me a difficult question. Shall it be so that it will require fifteen, twenty, or thirty minutes to raise the petroleum spirit from natural temperatures to its flashing-point (say 98° or 105° F.)? The Act does not state.

The following experiments made with six samples of petroleum spirit, placed in my hands by the magistrates of Manchester, will show how important the above question is with reference to the testing of petroleum spirit, and the absolute necessity, for the safety of the public as well as for the interests of those who deal in the article, that the Act should define the exact space of time that should be employed in the testing of any sample of petroleum spirit:—

Sample of petroleum spirit. at 52° F.	Time. 15 minutes.	Time. 20 minutes.	Time. 30 minutes.
No. 1. ..	96° F. ..	98° F. ..	102° F. ..
" 2. ..	92° ..	99° ..	101° ..
" 3. ..	90° ..	98° ..	101° ..
" 4. ..	94° ..	96° ..	104° ..
" 5. ..	96° ..	98° ..	110° ..
" 6. ..	95° ..	99° ..	108° ..

These results clearly show the influence of time in raising six samples of petroleum from 52° F. to their flashing-points. Thus, when fifteen or twenty minutes are employed, the whole six samples tested could not be called "petroleum," according to the Act of 1868, and the owner would be liable to a penalty, and to the loss of the fluids; whilst, if the time employed to heat the liquid is half-an-hour, they would all be considered petroleums, their flashing-points being above 100° F.

Therefore, there can be no doubt that, according to the time employed, so are the results altered; the longer an operator is in completing his test, the higher will be the flashing-point of the spirit. This fact is probably due that the most volatile products gradually escape in the atmosphere, and are never in sufficient quantity to produce a "flash" when a taper, as described in the Act, is passed within a quarter-of-an-inch from the surface of the spirit. I am, therefore, of opinion that, as the Act has been made to protect the public against fire, or explosions resulting from the employment of too highly inflammable hydrocarbons, the chemist or person called upon to test liquids of this class should raise the temperature of the fluids under examination as quickly as possible (of course, em-

ploying the apparatus described in the Act), otherwise, they favour the vendor and manufacturer, to the detriment of the consumers.

The next series of experiments were made with a view of corroborating a statement made by Mr. Norman Tate, Liverpool, viz., if two thermometers are placed into the petroleum spirit, one, as indicated in the Act, 1½ inches below the surface of the liquid, the other thermometer only ½ an inch, a difference of several degrees will be noticed between them at the time the vapours will flash; and I am happy to say that the following results confirm Mr. Tate's interesting observations.

	1½ inches. Flashed at	½ an inch. Flashed at
No. 4. ..	94° F. ..	99° F. ..
" 5. ..	94° ..	98° ..
" 6. ..	95° ..	99° ..

This curious and unusual fact of a fluid having a much higher temperature near the surface than it has an inch below what may be considered as the centre of the bulk of the fluid is due, in my opinion, that petroleum, not being a homogeneous liquid, but a mixture of several hydrocarbons, the highest products being first expelled, the heat rises towards the surface, and in this way produces the difference of temperature referred to. It was with a view of overcoming this practical difficulty that a series of experiments were instituted, in which the operations were conducted in the usual way, with this exception, that the liquid was kept in a constant state of agitation (except at the time when the flame was passed over to observe the flashing-point) by the thermometer; and the results obtained were as follows:—

No. 1	did not flash at 102° F.	
" 2	flashed at .. 99° F.	Fourteen minutes.
" 3	" .. 98° F.	"
" 4	" .. —	"
" 5	flashed at .. 98° F.	
" 6	" .. 104° F.	

These experiments appear to me to confirm the explanation above given on the cause which produced the difference of the two thermometers placed at unequal depths in the fluids under examination, for it will be observed that the flashing-points of the hydrocarbons are raised several degrees. In my opinion, this fact is due that agitation having facilitated the gradual escape of the most volatile products, the flash will not occur until a sufficient quantity of the more dense vapours have been volatilised and collected on the surface of the fluid to be tested.

I believe that many of the anomalies above described are principally owing to the difficulty—notwithstanding any amount of care that may be bestowed on the operation—to raise the temperature of the petroleum spirit from natural temperatures in a certain time (say fifteen, twenty, or thirty minutes) to their flashing-points. As the true flashing-points of the fluids depend entirely on the time employed in raising its temperature, I would propose the following method, which will enable every operator, in any part of the United Kingdom, to determine the flashing-point of a petroleum with certainty, and feel satisfied that another manipulator would obtain similar results.

The process consists in heating water to 10° above the flashing-point of the spirit (approximately tested) in the outer vessel (such as described in the Act), removing the flame, and then placing the can in the water, filling it at once carefully with the petroleum spirit. The thermometer should then be placed with the bulb ½ an inch below the surface of the spirit, and the flashing-point then ascertained in the usual manner. The following are the results I obtained with the same six samples of petroleum which I employed in my previous experiments:—



	First experiment.	Second experiment.
No. 1	flashed at 98.0° F.	.. .. 99° F.
„ 2	„ „ 95.0° „	.. .. 96° „
„ 3	„ „ 96.0° „	.. .. 97° „
„ 4	„ „ 96.0° „	.. .. 97° „
„ 5	„ „ 95.5° „	.. .. 97° „
„ 6	„ —	—

I am also of opinion that a gas-flame should be employed, in preference to a spirit-lamp, when the test is made in a similar manner to the directions given in the Act, as greater regularity in the rise of temperature can be secured. I have also used in my experiments (and I advise everyone to do so) the excellent suggestion made by Mr. Norman Tate—viz., a small gas-flame, instead of that produced by a match or taper, for testing the flashing-point of the spirit.

I consider the apparatus proposed by Mr. Miles would tend to give certainty to the assay, which, at the present time, cannot be satisfactorily performed. The above experiments prove that the Petroleum Act of 1868 does not give sufficient and precise instructions for the testing of petroleum spirit. Therefore it is to be hoped that Government will again take the matter in hand, and do away with the objections of the present Act, substituting more clearly defined rules and instructions, to enable the operator to determine the flashing points of petroleum spirit with greater accuracy.

## ON A

NEW STEP IN THE PROXIMATE ANALYSIS OF  
SACCHARINE MATTERS.\*

By JAMES APJOHN, M.D.,

Professor of Chemistry and Mineralogy in the University of Dublin.

THE proximate analysis of crude sugars and syrups is a problem of practical importance, and also one of considerable difficulty, as such generally include not only cane sugar, but, in addition, two other varieties of saccharine matter—viz., inverted sugar, and crystallised glucose, commonly called grape sugar. The amount, indeed, of the cane sugar admits, as is well known, of being readily determined by an optical method, in which we may employ Soleil's saccharometer, the previous saccharometer of Biot, or the much more sensitive instrument for which the scientific world is indebted to Professor Jellett. By taking, with one or the other of these instruments, the rotative power on plane polarised light of the saccharine material under consideration, both before and after it has been inverted by digestion with an acid, we obtain data from which, and certain constants, the required information may be deduced. If, for example, separate solutions of the three sugars already named be made, containing 416 grs. in 10 cubic inches, the rotative powers of a column of each 20 centimetres (7.87 inches) long, when measured on the French instrument (with the use of which I am most familiar) are known to be—

For cane sugar	.. ..	100°
„ inverted sugar	.. ..	36° at 59°
„ grape sugar	.. ..	76°

The rotative powers, therefore, of a single grain of each sugar made into syrup having the bulk already mentioned, and observed in the same tube, will be—

Cane sugar	.. ..	0.240
Inverted sugar	.. ..	0.086
Grape sugar	.. ..	0.182

Hence, the observed rotation before inversion being  $\theta$ , and after inversion  $\theta'$ , and  $x$ , representing the quantity of cane sugar,  $y$ , of inverted sugar,  $z$ , of grape sugar, we

arrive at the two following equations, in which it will be noted that the rotation produced by the inverted sugar has a negative sign, and that the coefficient of inversion of the cane sugar is 0.36 (Jellett) at 59° F.

$$x \times 0.24 - y \times 0.086 + z \times 0.182 = \theta \quad (1)$$

$$-x \times 0.24 \times 0.36 = y \times 0.086 + z \times 0.182 = \theta' \quad (2)$$

And subtracting the second of these equations from the first, we get—

$$x \times 0.24 + x \times 0.086 = \theta - \theta'$$

$$\theta - \theta'$$

$$x = \frac{\theta - \theta'}{0.326} \quad (2)$$

Very important information is thus rapidly obtained, for the most valuable constituent of any crude saccharine substance is the cane sugar which it includes. But the analysis is imperfect, for we do not learn from it the quantity of either of the two other sugars, nor even their aggregate amount, for this cannot be got by subtracting the cane sugar already determined from 416 grs., as much of the difference is water, and in many cases its estimation cannot be accurately effected by any process of drying.

And here it may be observed, that by chemistry alone, and without any assistance from optical science, we can advance a step further than the saccharometer conducts us. We can, for example, reduce Barreswill's solution of copper with a syrup, both before and after inversion. The latter experiment gives us the entire of the three sugars; the former, the sum of two of them, the inverted and grape sugar, while the difference of the results of the two experiments will correspond to the cane sugar. The chemical then goes a little beyond the optical method, for it not only tells us how much cane sugar is present, but, in addition, informs us of the exact aggregate amount of the two other sugars. Further than this it does not go; and we are still unable to assign the exact quantities of inverted and of cane sugar which may be present.

I have now to mention that, in conversing with Professor Jellett on this subject, he threw out the observation that, by combining the chemical and optical methods of experiment, the difficulty just alluded to might possibly be overcome, and the analysis rendered complete. Attaching much importance to his opinion on such a question, I turned the matter carefully in my mind, and soon found that his suggestion was quite correct, as will appear from the following explanation:—

By the optical method already adverted to, and with which physicists are long familiar, we obtain the quantity of the cane sugar; and by *inverting* the syrup, and applying it to the Barreswill's solution, we can get the entire amount of the three sugars, each being estimated on the hypothesis (we shall say) of its being grape sugar. The equations derivable from these two experiments are—

$$x \times 0.24 - y \times 0.086 + z \times 0.182 = \theta \quad (a)$$

$$x \times 1.16 + y \times 1.1 + z = w, \quad (b)$$

the first being the equation, already explained, which gives the rotative power of the syrup; the second, that which expresses the amount,  $w$ , of the three sugars, which, after *inversion*, has been estimated by the *blue solution*. The numerical coefficients in the former equation are, as previously stated, the unit *rotation* powers of the respective sugars, while, in the latter, 1.16 is the ratio of the half atomic weight of cane sugar to that of the atom of grape sugar; and 1.1 is the ratio of the atomic weight of *inverted* to that of grape sugar. Now, as by the optical experiment the amount of the cane sugar,  $x$ , has been determined, the first term in each of the equations is known, so that, as there are now only two unknown quantities,  $y$  and  $z$ , the value of each may be determined.

I have applied this method, on several occasions, in the proximate analysis of crude sugars and syrups, and with satisfactory results. The details of a single experiment recently made will be sufficient here. In operating on the variety of molasses called *golden syrup*, its *rotative*

\* From the *Transactions of the Royal Irish Academy*, vol. xxiv.—Science. Read December 13th, 1869.



powers, as given by Soleil's instrument, were found to be as follows:—

Before inversion ... .. 38°35'  
After inversion... .. -12°15'

Results from which we find, by equation (3) already given, the quantity of cane sugar in 416 parts of the syrup to be 154·95 grs. The second, or chemical experiment, was then made, which consisted in *inverting* 34·3 grs. of same syrup, and operating upon it with Barreswill's solution, which showed that the 34·3 grs. included 24·75 grs. of saccharine matter estimated as grape sugar, corresponding to 297·26 grs. from 416 of the syrup. Replacing, then,  $x$ , in equations (a) and (b) by its value, 154·9, and substituting in them 38·35 for  $\theta$ , and 154·9 for  $w$ , they become—

$$154\cdot9 \times 0\cdot24 - y \times 0\cdot086 + z \times 0\cdot182 = 38\cdot35 \quad (a)$$

$$154\cdot9 \times 1\cdot16 + y \times 1\cdot1 + z = 297\cdot26 \quad (b)$$

These equations involve only two unknown quantities, and therefore admit of solution, and when worked out we find—

$$y = 70\cdot66$$

$$z = 39\cdot89$$

so that the final numbers at which we arrive are the following, the figures in column (1) referring to 416 grs. of the syrup, and those in column (2) being percentages.

	(1)	(2)
Cane sugar .. .. .	154·95	37·17
Inverted sugar .. .. .	70·63	16·95
Grape sugar .. .. .	39·87	9·57
Water and other inactive matters..	150·55	36·31
	416·00	100·00

The 36·31 parts set down as water are got by difference. I may, however, observe, that by the direct process of drying *in vacuo* over oil of vitriol only 22 per cent could be obtained, so that it is possible that some gummy matter may be present. Its amount cannot exceed 14·31 per cent, and it is probably much less, as the perfect expulsion of moisture from syrup is, as already observed, a thing very difficult of accomplishment.

I must not close this short paper without stating that the optical observation which gives  $\theta'$  is one which it is difficult to make with the necessary degree of precision, for, though the syrup may be clarified by animal charcoal, in the process of inversion it invariably acquires a greater or less degree of colour. Fortunately, however, it is not necessary to make any optical experiment on the inverted syrup, for the object of such experiment is to enable us to calculate the amount of the cane sugar, and this can be done in a different way. It is, in fact, quite sufficient, as already explained, to apply Barreswill's solution, not only after inversion, but before it; and the difference of the two results will correspond to the cane sugar present in the syrup. The equations which express the results of these two experiments are the following:—

$$\text{Before inversion, } y \times 1\cdot1 + z = w', \quad (m)$$

$w'$  being the grape sugar corresponding to  $y$  and  $z$ .

$$\text{After inversion, } x \times 1\cdot16 + y \times 1\cdot1 + z = w, \quad (n)$$

$w$  being grape sugar, corresponding to  $x$ , to  $y$ , and to  $z$ . From which we deduce—

$$x = \frac{w - w'}{1\cdot16}.$$

In working upon this plan with 100 grs. of the specimen of molasses already mentioned, the following results were obtained:—

$$w' = 30\cdot64. \quad w = 72\cdot87.$$

From which *data* we find—

$$x = \frac{72\cdot87 - 30\cdot64}{1\cdot16} = 36\cdot44,$$

a number approximating closely to 37·17, the percentage of cane sugar as determined by the saccharometer.

From equation (m), too, we learn that the inverted sugar multiplied by 1·1, with the addition of the grape sugar, amounts to 30·64 grs. But by the conjoint aid of the saccharometer and the blue solution, it has been already shown that  $y = 16\cdot95$ , and that  $z = 9\cdot57$ , so that  $y \times 1\cdot1 + z = 28\cdot21$ .

There is manifested here, it must be admitted, an appreciable amount of divergence; for, instead of the chemical and optico-chemical methods of assay being in harmony with each other, we find that a result given by the former exceeds the corresponding one given by the latter by 2·43 per cent. The cause of this discrepancy it is not difficult to assign. It must obviously proceed from the presence in the molasses of some principle or principles different from either cane, inverted, or grape sugar, and which themselves exercise circular polarisation, and, mayhap, also exert a reducing action on Barreswill's blue solution. The substances of this nature, which may possibly be associated with the sugars in saccharine juices, are dextrin, asparagin, and tartaric acids; and when any such do exist in a saccharine product, its *exact* proximate analysis is rendered extremely difficult, if not impracticable. It is, therefore, scarcely necessary for me to state here that the optico-chemical process explained by me in this paper, will only give perfectly accurate results when applied to a mixture of cane, inverted, and grape sugars, in which no other *active* principle is contained. I may, however, add that the sugars just enumerated constitute the great bulk of all known saccharine products, and that, when other matters are present which complicate the problem, they are usually in such minute quantity as not to interfere materially with the success of my method when applied generally to the proximate analysis of saccharine products.

## ON THE ALLEGED SOLUBILITY OF GLYCERINE IN CHLOROFORM.

By HARRY NAPIER DRAPER, F.C.S.

In Watts's "Dictionary" (vol. ii., p. 887), it is stated that "glycerine dissolves in all proportions in chloroform;" and, at p. 889, a process is actually quoted for the detection and estimation of cane-sugar and glucose in glycerine, based upon the assumption of this solubility. The same method (apparently quoted from the same source) is also given in the CHEMICAL NEWS (vol. viii., p. 227).

It is not easy to conceive how Palm, who is the authority quoted by Watts for the analytical method, can have been misled by the somewhat easy *miscibility* of glycerine with chloroform to suppose that it was soluble in that body.

The following experiments were made with Price's glycerine, which had been kept for an hour at 136° C., and was then allowed to cool out of contact with the air.

(a). Equal volumes of glycerine and chloroform were shaken together in a graduated tube, and then allowed to rest. The two fluids completely separated, and their relative volumes were found to be unaltered.

(b). Ten c.c. of glycerine and 100 c.c. of chloroform were violently agitated together, and the mixture poured upon a filter moistened with chloroform. The liquid which passed through was then evaporated upon a water-bath. It left no residue.

(c). Experiment (b), repeated with boiling chloroform, gave an equally negative result.

I deduce from these experiments the conclusion that glycerine is absolutely insoluble in chloroform; and that, on the other hand, glycerine does not dissolve chloroform; and, as the chemical properties of all glycerines hitherto examined are alike, the statement in "Watts" must be considered incorrect, and the process of Palm as having no value.

Dublin, Feb. 15th, 1870.



ACTION OF  
CHLOROSULPHIDE OF PHOSPHORUS UPON  
ALCOHOL.

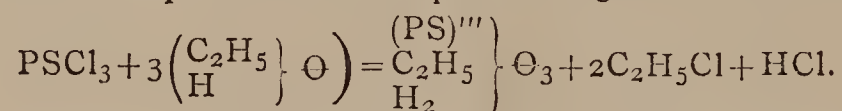
By M. CHEVRIER.

THE only enquiries relative to this subject were made by M. Cloëz, who, in 1847, prepared sulphoxyphosphoric acid and several of its salts, and, ten years later, examined the action of  $\text{PSCl}_3$  upon soda-alcohol, and obtained ethylsulphoxyphosphoric ether. His two notices are very short. The first contains no details of the secondary products of the reaction, which, moreover, is not formularised.

This subject has been my study, which was also extended to amylic alcohol.

The action of chlorosulphide of phosphorus upon alcohols is sufficiently complex; nevertheless, with care, it may be easily regulated, and the same products always obtained in the same proportions. (The only alcohols here alluded to are monatomic alcohols, corresponding with the fatty acids). With the first terms of the series (methylic and ethylic alcohols), the action is very lively; but it is less so in the case of more distant terms—such as amylic alcohol. In all cases, the result is a compound acid—the chloride of the alcoholic radical, with evolution of chlorhydric acid, which may be easily collected, so as to allow of the reaction being formularised.

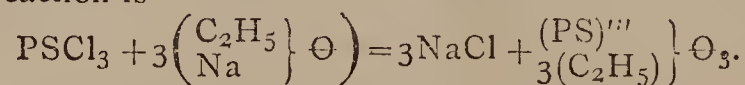
In the case of ordinary alcohol, the reaction is produced between 1 equiv. of chlorosulphide and 3 of alcohol.



By means of a special arrangement of the apparatus, all the chlorhydric acid and almost all the chloride of ethyl may be collected. The phenomenon is at all times more complex than the preceding equation would indicate; a small quantity of sulphur is precipitated, and a corresponding amount of ethylphosphoric acid is formed.

Ethylsulphoxyphosphoric acid is an oily liquid, heavier than water, which will not dissolve it, and having a nauseous odour. It is decomposed by dry distillation.

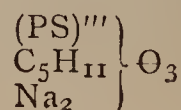
Soda-alcohol. The chlorosulphide,  $\text{PSCl}_3$ , reacts vigorously on soda-alcohol, and yields the corresponding ether discovered by M. Cloëz. All the chlorine of the  $\text{PSCl}_3$  is fixed upon the sodium in the alcohol. The formula of the reaction is—



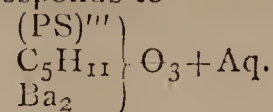
Ethylsulphoxyphosphoric ether is a colourless, oily liquid, insoluble in water, with an odour of rotten beet-root quite as disgusting as that of the corresponding acid. It can only be distilled in a current of steam.

Amylic alcohol. This may be slowly attacked at the ordinary temperature by chlorosulphide of phosphorus. The reaction is facilitated by stirring the mixture, to lessen the viscosity, and heating it in a water-bath. Abundant evolution of chlorhydric acid ensues, with formation of chloride of amyl and amylsulphoxyphosphoric acid. These two liquids are separated by heating the mixture to  $105^\circ$ . The residue is re-dissolved in alcohol, to separate the small quantity of sulphur, and then heated to  $100^\circ$ . The liquid thus obtained is oily, lighter than water (in which it is insoluble), and soluble in alcohol. It is decomposable by dry distillation at about  $145^\circ$ , but is easily distilled in a current of steam. One of its salts was prepared.

Alkaline amylsulphoxyphosphates and the baryta salt are very soluble in water. They are greasy to the touch, like all salts which contain the radical,  $\text{C}_5\text{H}_{11}$ , of amylic alcohol. The formula of the soda salt is—

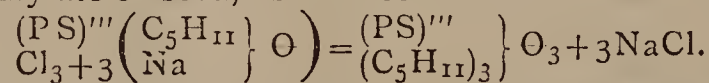


That of baryta corresponds to—

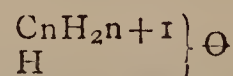


The copper salt is of a greenish-blue colour. It may be used to prepare amylsulphoxyphosphoric acid, by treating it with a current of sulphuretted hydrogen. The crystals of amylsulphoxyphosphates produce very easily the phenomenon of epipolism. When thrown into perfectly pure water, they turn about like camphor until completely dissolved; the least trace of fatty matter will, however, stop the gyratory movement. Epipolic power was ascertained to be present in sundry crystals containing the radical amyl, particularly the sulphamate of baryta: crystals of phenic acid are similar in this respect.

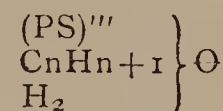
Amylate of Soda.—The action of  $\text{PSCl}_3$  on amylate of soda is very energetic. The sodium alcohol is placed in a retort or spherical receiver, and the liquid added to it, drop by drop. The products of the reaction are then treated with water, which dissolves the chloride of sodium formed, and separates an oily liquid, which collects on the surface: this is amylsulphoxyphosphoric ether, a colourless liquid, which in time becomes slightly greenish. It distils in a current of steam, without decomposition. Its density at  $12^\circ$  is equal to 0.849. Its degree of refraction corresponding to the yellow ray of sodium is equal to 1.42. Reaction occurs between 1 equiv. of chlorosulphide and 3 of amylate of soda, as with common alcohol.



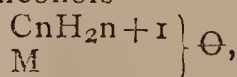
In the case of monoatomic alcohols represented by the general formula—



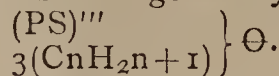
the chlorosulphide of phosphorus gives the corresponding combined acid—



the chloride of the alcoholic radical  $\text{C}_n\text{H}_{n+1}\text{Cl}$  and of chlorhydric acid. Whilst reacting upon the metallic derivatives of these alcohols—



the chlorosulphide  $\text{PSCl}_3$  produces an ether analogous to the fatty bodies, represented generally by—



If the kind of decomposition to which chlorosulphide of phosphorus is subject in the presence of those simple or compound bodies upon which its action is exercised be carefully examined, it will be seen that its action is at the same time chlorising and sulphurising. The triatomic radical  $(\text{PS})'''$  has a remarkable tendency to substitution in compounds.

All oxygenated compounds which yield the oxychloride  $\text{POCl}_3$  form corresponding sulphuretted compounds furnished by chlorosulphide,  $\text{PSCl}_3$ . This liquid constitutes an excellent reagent for the substitution of sulphur for oxygen.

## ON MICROSCOPICAL MANIPULATION.\*

By W. T. SUFFOLK, F.R.M.S.

(Continued from p. 63).

IN the following lessons, the possession of an instrument fitted with Mr. Wenham's stereoscopic binocular arrangement has been supposed. As

\* The substance of a course of lectures delivered to the members of the Quekett Microscopical Club, January–April, 1869. This and the following articles contain such portions of the demonstrations after the lectures as could not conveniently be incorporated with the preceding text. Much new matter has also been added.



microscopes of moderate price are now so constructed, the author has no hesitation in arranging the following simple course of exercises more especially for its use; nearly all the observations can, however, be made with the monocular instrument.

The following tables, containing lists of the objectives made by the three principal London opticians, with their approximate magnifying powers and angles of aperture, may assist the student in selecting a glass suitable for the object to be examined. It must be borne in mind that the powers given are those of the lenses when used upon the stands of their respective makers; the length of the body materially influences the power of the combination, as will be seen by the table for the use of the draw-tube given in Messrs. Beck's list:—

The screws cut upon the nozzles of microscopes, and upon object-glasses, are now common among English opticians, so that the objectives may be attached to any stand at pleasure.

The following symbols will be employed to indicate the apparatus to be used.

Object-Glasses—

4 in. or 3 in. . . . .	O <sub>3</sub>
2 „ 1½ „ . . . . .	O <sub>2</sub>
1 „ ¾ „ . . . . .	O <sub>1</sub>
½ „ ⅓ „ . . . . .	O <sub>½</sub>
¼ „ ⅛ „ . . . . .	O <sub>¼</sub>

Higher powers, O, with the fraction indicating the nominal focal length.

Eye-Pieces.—When no symbol is used, the lowest power, viz., No. 1, or A, is supposed; medium power,

R. and J. BECK.

Focal Length.			Linear Magnifying Power (nearly) with Eye-Pieces.					Angle of Aperture about
			1	2	3	4	5	
3 inches	Draw-tube closed . . . . .	..	12	20	40	48	74	12 degs.
	Do. if drawn out, add for each inch . . . . .	..	2	4	6	7	10	
2 „	Draw-tube closed . . . . .	..	20	38	70	85	130	18 „
	Do. if drawn out, add for each inch . . . . .	..	4	6	8	12	15	
1½ „	Draw-tube closed . . . . .	..	30	56	100	120	190	23 „
	Do. if drawn out, add for each inch . . . . .	..	5	7	12	15	22	
¾ „	Draw-tube closed . . . . .	..	70	120	220	270	410	32 „
	Do. if drawn out, add for each inch . . . . .	..	8	14	25	27	48	
⅔ „	Draw-tube closed . . . . .	..	120	210	370	460	710	55 „
	Do. if drawn out, add for each inch . . . . .	..	14	24	34	46	70	
⅕ „	Draw-tube closed . . . . .	..	146	255	460	560	890	90 „
	Do. if drawn out, add for each inch . . . . .	..	18	32	48	60	80	
¼ „	Draw-tube closed . . . . .	..	200	340	590	720	1120	75 „
	Do. if drawn out, add for each inch . . . . .	..	24	42	63	85	120	
⅓ „	Draw-tube closed . . . . .	..	225	400	700	860	1450	85 „
	Do. if drawn out, add for each inch . . . . .	..	18	35	60	80	130	
⅓ „	Draw-tube closed . . . . .	..	225	400	700	860	1450	100 „
	Do. if drawn out, add for each inch . . . . .	..	18	35	60	80	130	
⅓ „	Draw-tube closed . . . . .	..	500	870	1500	1850	2800	120 „
	Do. if drawn out, add for each inch . . . . .	..	60	100	180	190	370	
⅓ „	Draw-tube closed . . . . .	..	900	1570	2750	3450	4950	140 „
	Do. if drawn out, add for each inch . . . . .	..	80	150	300	350	900	

THOMAS ROSS.

Object Glasses.	Angular Aperture.	Magnifying Powers with the various Eye-Pieces.					
		A	B	C	D	E	F
5 inches	7 degs.	8	13	24	36	52	72
4 „	9 „	10	16	30	45	65	90
3 „	12 „	13	20	35	56	84	112
2 „	15 „	20	32	55	90	135	180
1½ „	20 „	25	40	70	112	168	224
1 „	15 „	37	60	105	170	255	340
1 „	25 „	37	60	105	170	255	340
¾ „	35 „	60	100	145	270	405	540
½ „	90 „	95	153	265	420	630	840
⅔ „	110 „	140	220	370	650	975	1300
⅕ „	100 „	195	310	540	850	1275	1700
¼ „	140 „	195	310	540	850	1275	1700
⅓ „	140 „	320	510	700	910	1360	1820
⅓ „	140 „	420	670	900	1200	1800	2400
⅓ „	170 „	600	870	1200	2000	3000	4000

POWELL AND LEALAND.

Object Glasses.	Angular Aperture.	Magnifying Power with the various Eye-Pieces.				
		1	2	3	4	5
2 inches	14 degrees	25	37	50	100	150
1½ „	20 „	37	56	74	150	220
1 „	30 „	50	74	100	200	300
¾ „	32 „	75	111	150	300	450
½ „	70 „	100	148	200	400	600
⅔ „	80 „	125	187	250	500	750
⅕ „	95 „	200	296	400	800	1200
¼ „	130 „	—	—	—	—	—
⅓ „	145 „	—	—	—	—	—
⅓ „	100 „	250	370	500	1000	1500
⅓ „	140 „	400	592	800	1600	2400
⅓ „	145 „	600	888	1200	2400	3600
⅓ „	175 „	800	1184	1600	3200	4800
⅓ „	160 „	1250	1850	2500	5000	7500
⅓ „	150 „	2500	3700	5000	10000	15000

E 2; deeper, E 3; return from deep eye-piece to one of lower power, E.

The binocular prism is supposed to be employed in general; when it is to be withdrawn, and the instrument rendered monocular, M is used; the return to the binocular is indicated by B.

The illuminating apparatus first mentioned is that

to be used if possible; that following, between brackets, may be used as a substitute.

The apparatus and materials constantly required, besides the microscope, are—

Lamp (vol. xx., p. 158).—A glass stage-plate; easily made by attaching a narrow slip of glass, with marine glue (vol. xx., p. 171), to a glass plate of convenient



dimensions, so as to form a ledge, and prevent objects slipping off when the stage is inclined.

Some  $3 \times 1$  slides; a small stock of thin cover glass, in squares and circles; forceps; needles mounted in handles (vol. xx., p. 182); a few pipettes (vol. xx., p. 170), and some blotting-paper; a small quantity of alcohol and turpentine; and also a supply of water should be at hand.

The following books, being often referred to, will be quoted with abbreviated titles:—

*Carpenter*.—"The Microscope and its Revelations," by W. B. Carpenter, M.D. (4th edition, 1868.)

*Beale*.—"How to Work with the Microscope," by Dr. L. S. Beale, F.R.S. (1868.)

*Hassall*.—"Adulterations Detected," by A. H. Hassall, M.D.

(To be continued.)

### GALVANOSCOPIC LANTERN.

By EDWIN SMITH, M.A.

HAVING occasion to exhibit to an audience some of my recent experiments on the electrical phenomena of plants, I was obliged to invent some means of throwing the image of the index of a sensitive galvanometer upon a screen. I did not want to use the electric light, or to add the weight of even a small mirror to the astatic needles; otherwise a bright spot of light might have been made to indicate the deflections on the plan of a Thomson's galvanometer. After a good many trials of various expedients I hit upon the following, which I found to answer my purpose admirably. It is an application of the principle of the magic lantern, and is at once simple and effective. It requires no stronger light than that afforded by a large belmontine lamp. The hands of the operator, not being wanted for troublesome adjustments of the illumination, are at liberty for the performance of his experiments. The apparatus is also inexpensive. No iron must, of course, enter into its structure: I made mine of wood with brass screws, only adding a copper chimney to the box which contained the lamp. The light thus enclosed is placed in the focus of a large condensing lens. A circular aperture is left in the lamp-box of the same size as the lens for that purpose. The rays being made parallel by the condenser fall upon a mirror behind, sloped at an angle of  $45^\circ$ , and are thus thrown upwards past the moving index of the galvanometer. This index, formed of the lightest possible stem of grass, is fixed at right angles to the upper needle, and projects horizontally over the lower mirror before mentioned. Just above the index, and in the top of the box, are placed the front lenses of a magic lantern, which throw divergent rays upon a second mirror, also inclined at a suitable angle, by which they are finally cast upon the white screen. It is best to adjust the lower mirror first with regard to the light, then to adjust the sliding lenses, till a distinct black image of the index is obtained stretching across a bright field. The front and the back of this apparatus may be made movable to enable one to get at the interior when necessary. An upright narrow case of cardboard, strengthened by two parallel ends of wood, should be placed so as to contain the arrangements for suspending the needles, and prevent gusts of air from disturbing them. Two mercury cups may be drilled behind the box in the thick board which forms its bottom, and which should project beyond the sides for the purpose of carrying three or four levelling-screws. Every part of the box, inside and outside, must be stained black.

I can strongly recommend the above contrivance to the notice of teachers and lecturers. A popular audience seems to understand the clock-like movements of a black

finger upon a screen more readily than the linear motions of a bright spot. The spectators feel as if they saw the needle itself which is being deflected by voltaic currents.

## PROCEEDINGS OF SOCIETIES.

### CHEMICAL SOCIETY.

February 17th, 1870.

Dr. A. W. WILLIAMSON, F.R.S., &c., President, in the Chair.

THE following gentlemen were elected Fellows:—R. T. Atcherley, T. W. Axe, A. H. Bateman, E. Francis, A. Prangley, W. Pritchard, L. B. Ross, T. G. Rylands, T. Wills, P. Wright.

An account was given by Professor Tyndall of his researches on "*The Action of Light on Gases and Vapours*," illustrated by a series of beautiful experiments.

Dr. TYNDALL began by remarking that it had, for the last ten years, been his endeavour to make radiant heat a means of getting an insight into the working of the atomic forces, or, in other words, into the state which is called chemical combination. Whilst pursuing his experiments with luminous waves on matter in a finely-divided state, he was forced to imagine molecules and atoms; indeed, his belief in the existence of atoms is founded more upon those physical evidences than upon the considerations which are current in the chemical world. If he had to give up the notion of atoms, and to replace that conception by the abstract idea of multiple proportions, he would feel completely at a loss how to account for changes in the physical properties of matter. After these introductory remarks, the lecturer proceeded to the main subject. The apparatus which served to illustrate the statements consisted of a glass tube, about 3 feet in length and about 3 inches internal diameter, closed at each end by glass discs. This tube, after having been exhausted by an air-pump, was partially filled with dry air which had been permitted to bubble through the liquid whose vapours were to be examined. The condensed beam of an electric lamp was now caused to pass through the tube from end to end.

Since the aim of these experiments is to render visible the chemical action of light upon vapours, substances have been chosen, one, at least, of whose products of decomposition by light has so high a boiling-point that, as soon as it is formed, it is precipitated. Nitrous oxide gas, the vapours of amylic iodide, amylic nitrite, benzol, &c., mixed with some air which had passed through hydric nitrate or hydric chloride, were found well suited for this purpose. In all cases, no matter what the nature of the vapour was, if only employed in a sufficiently attenuated state, the visible action commenced with the formation of a blue cloud, which, in some instances, was of the deepest azure tinge, rivalling the colour of the purest Italian sky. When a cell containing some of the liquid whose vapours were to be examined was inserted between the lamp and the tube, no clouds were formed within the tube—the luminous waves traversing the liquid had been deprived of their acting power. When polarised light was sent through the tube, the blue cloud was visible only in one direction, the direction varying according to the position of the Nicol prism. When the short diagonal of the Nicol was vertical, the blue cloud was seen when the spectator's eye looked horizontally upon the tube, not otherwise. As soon as the prism was turned round its axis, the blue cloud was only seen when the line of vision fell vertically upon the experimental tube.

After concluding this account of this highly interesting subject, Professor Tyndall showed some of the experi-



ments bearing on his researches upon Dust, quite recently communicated at the Royal Institution.

The next meeting of the Society will take place on March 3rd, when Dr. Gladstone will deliver a lecture on "Indices of Refraction."

# MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, February 8, 1870.

J. P. JOULE, LL.D., F.R.S., President in the Chair.

MR. SPENCE repeated the experiment he had made at the Exeter meeting of the British Association, showing that the temperature of saturated saline solutions could be raised to their boiling points by merely passing through them ordinary steam at a temperature of  $212^{\circ}$ . Thus, a solution of chloride of sodium was raised to a temperature of  $221^{\circ}$ , and one of chloride of calcium to  $248^{\circ}$ . Chloride of sodium would have risen to  $224.3^{\circ}$  and chloride of calcium to  $286^{\circ}$  had the experiment been continued, but the point was sufficiently demonstrated that by steam of  $212^{\circ}$  much higher temperatures can be obtained.

# GLASGOW PHILOSOPHICAL SOCIETY.

(CHEMICAL SECTION).

Ordinary Meeting, February 14, 1870.

Mr. E. C. C. STANFORD, F.C.S., in the Chair.

THE first paper was on "*Some Notes on Californian Borax*," by Mr. Archibald Campbell, St. Rollox Chemical Works. The author referred briefly to the borax as obtained from Thibet under the name of tincal; and that of the Lagoons of Tuscany, and then he spoke of the boracic compounds obtained within the last few years in Peru. In the latter case, the deposit consists chiefly of borate, of lime with varying quantities of borate of soda. Having spoken at some length of the Peruvian deposits and of the opinions expressed by Mr. Walker (CHEMICAL NEWS, vol. xviii., p. 203), regarding their origin, Mr. Campbell stated that borax had lately been found at Halberstadt in Transylvania, in Ceylon, in several mineral springs in Canada East, and in the waters of the sea along the coast of California. The most important discovery of borax in recent years is that of the Borax Lake of California, a description of which was given by Mr. Campbell. It is about 40 miles from the Pacific, and 60 miles from Suisun Bay. Between it and Clear Lake (a lake about 25 miles long) there is a large accumulation of volcanic materials, containing much obsidian and pumice-stone, lying loosely heaped together in a ridge which separates the two lakes; in fact, all through the mountain ranges on the coast in the region under notice, there are hot springs and the remains of solfatara action. These strongly indicate a cross fracture, through which the volcanic agencies have made themselves perceptible, and which probably forms a connection on the south-west with the geysers, thus forming a line of volcanic action nearly, if not quite, across the mountain chain. It is in this peculiarly volcanic action that the Borax Lake is situated. The lake is of variable size, according to the season of the year and the comparative dryness of the season. In September, 1863, the water occupied an area about 4000 feet long, and 1800 feet wide in the widest part. Its length has been twice as great as it is at present, as is evident from the nature of the ground. In some very dry seasons, the lake is rendered entirely dry: in September, 1863, however, the water was about 3 feet deep. The existence of the lake was first made known to

the world by Dr. Veatch, who examined it in September 1856, and detected borax in its waters. It was not until some months afterwards that the existence of a large bed of borax crystals was discovered in the bottom of the lake. The land in the district belongs to the California Borax Company.

The water collected from the lake in 1863, on being analysed, was shown to contain 2401.56 grains of solid matter per gallon, of which about one-half was common salt, one-fourth carbonate of soda, and the remainder chiefly borate of soda—there being 281.48 grains of the anhydrous borate, equal to 535.08 of crystallised borax to the gallon, or, in other words, 13 gallons of the water are equal to 1 lb. of the borax crystals. Traces of iodides and bromides were also found. A sample of water taken from a coffer-dam sunk in the middle of the lake was more concentrated. There were 3573.46 grains of solid matter per gallon; but the same ingredients were found, and in nearly the same proportions as in the water of the lake itself. The crystals vary in size, from those which are microscopic to such as are 2 or 3 inches across. They are mixed with bluish mud, and sometimes there are several alternating layers of mud and crystals of borax. It is believed that there are several thousand tons at the bottom of the lake. The crude borax is obtained so pure that it is used by the San Francisco assayers in preference to the refined borax imported from abroad. In the neighbourhood of the lake, there is a hot spring of a remarkable character, and said to yield about 300 gallons per minute. Mr. Campbell gave the following analysis of the water of the spring, the figures representing grains per gallon:—

Chloride of potassium .. ..	trace
"    "    sodium .. ..	84.62
Iodide of magnesium .. ..	0.09
Bromide of magnesium .. ..	trace
Bicarbonate of soda .. ..	76.96
"    "    ammonia .. ..	107.76
Biborate of soda .. ..	103.29
Sulphate of lime .. ..	trace
Alumina .. ..	1.26
Carbonic acid (free) .. ..	36.37
Silicic acid .. ..	8.23
Matter volatile at a red heat ..	65.77

484.35

These figures necessarily represent anhydrous salts and, therefore, the 103.29 grains of biborate of soda represent 195.35 grains of crystallised borax.

The author had not ascertained the temperature of the spring, but it could not be high, owing to the great amount of bicarbonates, and from carbonic acid present in solution. He considered the most extraordinary feature of the analysis to be the very large quantity of ammoniacal salt present—exceeding, he believed, that of any spring yet analysed.

MR. CAMPBELL afterwards read a short paper on "*Notes on Silician Sulphur*." He gave an account of the mode in which sulphur is distributed in nature, and of the various theories held regarding the formation of sulphur deposits. Some peculiar properties of sulphur were next spoken of; and the author concluded by mentioning some details regarding the means adopted for the extraction of the sulphur from the mineral masses in which it occurs in Sicily.

The author exhibited several specimens of Californian borax and Silician sulphur. A short discussion followed, the remarks being especially directed to the peculiarities of the analysis given above and the probable source of the nitrogen of the ammonia.

The next communication was entitled "*On the Composition of Ooze or Chalk Mud from the Atlantic Sea Bed*," by Mr. JAMES MAHONY.

The author spoke of the interest that has been felt regarding the nature of the Atlantic sea bottom, and the conditions of life there present, ever since the first surveys



were made in connection with the Atlantic telegraph cable. Previous to that time Professor Edward Forbes had expressed the opinion that organised beings could not live at greater depths than 200 fathoms; but Dr. Wallich had shown that animal life did exist even at a depth of 1260 fathoms, and that it was represented by various species of starfish and *Globigerina*; and, further, that the comparatively level plateau extending from Ireland to America was covered by a fine white mud, to which the name of "ooze" had been given. Mr. Mahony then referred to the deep-sea dredging expeditions of H.M.S. *Porcupine*, and stated that he had been favoured with a sample of the ooze lately sent to a scientific friend in Glasgow, by Professor Wyville Thomson. It was obtained from the deepest dredging, 2435 fathoms, about 150 miles west of Ushant, the temperature of the sea bottom being 36.5°. Part of the sample was air-dried and a small portion was put, when fresh, into methylated spirit. Mr. Mahony had examined the ooze both as a chemist and as a naturalist. The following is the analysis:—

Silica .. .. .	26.60
Peroxide of iron and phosphates ..	3.80
Protoxide of iron .. .. .	0.08
Carbonate of lime .. .. .	58.80
Carbonate of magnesia .. .. .	1.76
Sulphate of lime .. .. .	trace
Soluble salts .. .. .	4.20
Organic matter .. .. .	2.30
Water .. .. .	2.50

100.04

The silica was found under the microscope to consist chiefly of minute structureless fragments, some of them being crystalline. A small number of diatoms were also found. The calcic carbonate consisted of larger organisms (class *Foraminifera*), some still containing the small particle of jelly-like matter constituting the animal substance of these organisms, and called *sarcode* by Dujardin. These doubtless yielded the organic matter noted in the analysis. The soluble salts were accounted for by the evaporation of the sea water with which the mud was charged when taken up.

Mr. Mahony then considered the question—"Does the presence of the gelatinous contents of the foraminifers indicate that they live and die on the sea bottom?" So far as the aëration of the water was concerned, he found no difficulty, especially when looking at the subject in the light thrown upon it by Mr. John Hunter's recent paper "On Analysis of Sea-Water Performed on Board the *Porcupine*" (*Journal of the Chemical Society* for January, 1870). He concluded his paper by stating that over the North-Atlantic sea-bed the chalk formation is in continued progress, the identity of the ooze with chalk, both chemically and organically, being very apparent. The siliceous grains have their counterpart in the layers of flint seen in the chalk cliffs,—probably formed by the aggregation of minute particles round a central nucleus,—while the species of minute shells found in the ooze are in many cases identical with those entombed long ages ago.

A short discussion followed, and then Mr. Stanford vacated the chair to read two short papers. The first was entitled "Note on a Specimen of Shell Sand from the Island of Coll." The specimen examined had the following analysis:—

Carbonate of lime .. .. .	68.50
Carbonate of magnesia .. .. .	1.51
Silica sand .. .. .	25.69
Phosphates, iron, and alumina ..	2.00
Organic matter .. .. .	2.30

100.00

It was very much agglutinated, owing to the carbonate of lime which the rain-water had taken up and afterwards deposited over the exposed grains of sand. The author

mentioned that most of the islands of the Outer Hebrides have similar deposits of sand on their west coast, the east being covered with peat. The sand is generally composed almost entirely of the *débris* of shells of countless generations of mollusca. In the silica sand mentioned in the analysis there was felspar, and therefore potash. A trace of nitrogen was present in the organic matter. The specimen was much weathered, and, therefore, did not contain as much nitrogen as there would doubtless have been in the fresh state. Where the sand does not "blow" it bears a luxuriant crop of white clover, which is specially remarkable in North and South Uist. The presence of magnesia shows it to be a good food for clover. By mixing the shell sand with the peat an excellent soil is produced. With lime it forms a remarkably strong mortar, almost equal to a cement.

Mr. Stanford's next paper was a "Note on Iodide of Cyanogen," the result of the examination of a specimen of that compound which he had recently found while re-subliming a lot of inferior iodine purchased in London. Although the impurity was said to be a common one, he had never met with it in any quantity before. Mr. Stanford detailed its properties and its reactions.

## MISCELLANEOUS.

**Chemical Society.**—The following is the Council's list for the election of officers on March 30th, 1870:—President—A. W. Williamson, Ph.D., F.R.S. Vice-Presidents who have filled the office of President—Sir B. C. Brodie, F.R.S.; Warren De la Rue, Ph.D., F.R.S.; A. W. Hofmann, D.C.L., F.R.S.; W. A. Miller, M.D., D.C.L., V.P.R.S.; Lyon Playfair, M.P., Ph.D., C.B., F.R.S.; Col. P. Yorke, F.R.S. Vice-Presidents—E. Frankland, Ph.D., F.R.S.; J. H. Gilbert, Ph.D., F.R.S.; A. Matthiessen, Ph.D., F.R.S.; H. M. Noad, Ph.D., F.R.S.; W. Odling, M.B., F.R.S.; T. Redwood, Ph.D. Secretaries—A. Vernon Harcourt, M.A., F.R.S.; W. H. Perkin, F.R.S. Foreign Secretary—H. Müller, Ph.D., F.R.S. Treasurer—F. A. Abel, F.R.S. Other Members of Council—E. Atkinson, Ph.D.; H. Bassett; E. T. Chapman; David Forbes, F.R.S.; F. Field, F.R.S.; Dr. M. Holzmänn; E. J. Mills, D.Sc.; W. J. Russell, Ph.D.; Maxwell Simpson, Ph.D., F.R.S.; R. Angus Smith, Ph.D., F.R.S.; A. Voelcker, Ph.D.

**Flower Farms—Premiums for Odours of Plants.**—The following premiums have been placed at the disposal of the Council of the Society for the Encouragement of Arts, Manufactures, and Commerce, for the term of seven years, by Dr. Septimus Piesse, F.C.S.:—1. A premium of £5, for one pound of otto of bergamot, of the value of 16s. or more in the London market, being the produce of plants (*Citrus Bergamia*) grown in Australia, New Zealand, Natal, any of the British West India Islands, or any other British Colony or Dependency. 2. A premium of £5, for 1 oz. of otto of roses, of the value of £1 or more in the London market, being the produce of any variety of roses grown together in one plantation in the above-mentioned Colonies. 3. A premium of £10, for a canister of enflowered butter or fat, so scented with any kind or sort of flower, either by infusion or enfleurage, or by means of these processes jointly, of the weight of 3 lbs. or more, and of the value of 6s. per lb. in London; the said butter or fat to be enflowered or infused with flowers grown for the purpose in the British Colonies.

**On the Use of Ether as an Intoxicant in the North of Ireland.**—We have received from Mr. H. N. Draper a pamphlet on the above subject from which we learn that the use of methylated ether instead of alcohol is very general in the counties of Londonderry, Antrim, and Tyrone. The quantity taken at one time is from two to four drachms and the dose is repeated twice, thrice, or even four and six times daily. Mr. Draper treats the



subject in its relation to the Inland Revenue and also to insurance companies, the former suffering by the practice to the extent of £5666 per annum, while the risks of the latter are increased by such an inflammable liquid being stored and handled by people ignorant of its properties.

**Water Supply of London.**—We have received from Dr. Letheby his report on the sanitary condition of London, in which he says the chemical composition of the metropolitan water has not fluctuated to any considerable extent; for that derived from the Thames and the Lea has contained from 21 to 23 grains of solid matter per imperial gallon during the winter months, when the rainfall is the greatest, and from 17 to 17.5 grains per gallon in the summer, when it is least, the average for the whole year being about 19.3 grains per gallon, of which about 14.2 grains are calcareous salts, giving that degree of hardness to the water, the hardness being reduced to about 3.8 degrees by boiling the water for a quarter of an hour. The proportion of common salt in the water does not exceed 1.8 grains per gallon, and the organic matter, as estimated by the oxygen required to oxidise it, is not above two-thirds of a grain per gallon. The nitrogenous matter also is remarkably small, ammonia being in the proportion of only one part to about 35,000,000 parts of water, and the nitrogen, as nitrates, &c., as one to 630,000 parts. The water supplied to the public is for the most part clear and colourless; on one occasion, however, during the year, it was slightly turbid in the case of the Grand Junction water; on two occasions with the Southwark and Vauxhall water; on four with the Lambeth; and on six with the Chelsea. The daily supply of water to the metropolis has ranged from 91,578,341 gallons per day, in the month of January last, to 110,094,058 gallons in the month of July, the average for the whole year being rather more than 99,000,000 of gallons per day, or 31.2 gallons per head of the population. The daily supply to Paris averaged 46,561,472 gallons per day, or 24.6 gallons per head of the population; but this includes the water supplied to the public fountains, ornamental waters, &c. The number of houses supplied daily by the water companies of London is about 463,000. Rather more than half of the water is obtained from the River Thames at Hampton, and the rest is from the Lea, and from springs and wells in the chalk. The supply to Paris is derived chiefly from the Canal d'Ourcq and the River Seine. None of the Paris water is filtered, and is always more or less turbid when it reaches the consumer. In London, however, the water is filtered, generally in a very effective manner. It is remarked that, except in special cases, water of moderate hardness, like that supplied to the metropolis, to Paris, and Vienna is always preferred, and is best suited for domestic purposes, because of its being brighter to the eye and more agreeable to the taste. So satisfied, indeed, were the French authorities on this head, that they passed by the soft waters of the sandy plains near Paris, and went far away to the chalk hills of Champagne, where they found a water which is even harder than that supplied to London. One important consideration which strongly influenced them in their decision was the fact that more conscripts are rejected in the soft-water districts, on account of imperfect development and stunted growth, than in the hard; and they conclude that calcareous matter in water is essential to the formation of tissues. In this country, also, it is remarkable that, wherever soft water is supplied to the people, the mortality is large, even when allowance is made for the birth-rate of the place. Glasgow, for example, as well as Preston, Dundee, Sheffield, Plymouth, Manchester, Bradford, &c., which are all supplied with water of less than 4 degrees of hardness, have a mortality which ranges from 26 to 34 per 1000, while at Birmingham, Bristol, Sunderland, Newcastle-on-Tyne, Wakefield, Dover, Norwich, Croydon, Worcester, Derby, and other places, where the waters are hard, the mortality is considerably less; in fact, it may be said that in towns sup-

plied with water of more than 10 degrees of hardness, the average mortality is about 22 per 1000, while in those supplied with softer water it is about 26 per 1000. It may well be, as the late Professor Johnson observed, that "the bright sparkling hard waters which gush out in frequent springs from our chalk and other limestone rocks are relished to drink, not merely because they are grateful to the eye, but because there is something exhilarating in the excess of carbonic acid they contain and give off; and because the lime they hold in solution removes acid matters from the stomach, and thus acts as a grateful medicine to the system. To abandon the use of such a water, and to drink daily in its stead one entirely free from mineral matter, so far from improving the health, may injure it. The water of a country may determine the diet of its inhabitants. The soft water of the lakes of Scotland may have had much to do with the use of brown meal; and but for the calcareous waters of Ireland the potato could not have become a national food." Looking at the plain teachings of all this, and considering the excellent quality of the water supplied to this metropolis, it would be folly, in my opinion, to change it for a soft water. On the other hand, it is quite possible to have an excess of calcareous and other saline matters, as is the case with the well waters of this city, where the proportion ranges from 48 to 120 grains per gallon. Dr. Letheby concludes with a report of the sanitary work done in the city during the year.

## CORRESPONDENCE.

### MONAD ELEMENTS.

*To the Editor of the Chemical News.*

SIR,—In the CHEMICAL NEWS (vol. xxi., p. 80), Mr. George Davis has touched upon a subject especially interesting to me, as, during the last thirteen months, I have made it my study. Many circumstances (among which a prolonged absence in the country, away from all books of reference, and a wish to collect more and more evidence in their support) have combined to defer the publication of my views of the so-called monad elements; I hope, however, now speedily to make them known. I may shortly state that, by assuming triad functions for the univalent class of bodies, I have been able to explain the existence of many compounds hitherto unclassified and regarded, as Mr. Wanklyn says, as "freaks of nature."—I am, &c.,

WALTER NOEL HARTLEY.

Dr. Odling's Laboratory, Royal Institution,  
February 23rd, 1870.

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

*Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

*Comptes Rendus des Séances de l'Académie des Sciences, February 14, 1870.*

This number contains the following papers relating to chemistry and allied sciences:—

**Galvanic Element with Three Fluids.**—F. Zaliwski.—This contrivance consists of two porous cells placed one inside the other and surrounded by another suitable vessel. The inner vessel contains



nitric acid and a piece of carbon; the intermediate vessel contains sulphuric acid; and the outer vessel a solution of sal-ammoniac in water and a piece of zinc. The author states that this arrangement is very superior to a Bunsen cell.

**Accidental Images of White-Coloured Objects.**—J. M. Seguin.—A continuation of a former paper on this subject.

**Geological and Agronomical Map of the Département de la Haute-Vienne.**—J. Mallard.—M. Elie de Beaumont calls the attention of the meeting to this map, on account of the excellent manner in which it has been executed by means of chromo-lithography. The description given is too lengthy for full reproduction here; but the utility of such local maps, executed with minute accuracy and on a large scale, must be evident.

**Fusion of Platinum.**—Dr. St. Claire-Deville states that an error has accidentally been made in the *Compte Rendu* of the last meeting, and that it is the oxygen, not the hydrogen, dissolved during the fusion of platinum, which gives rise to this metal, presenting the same phenomenon as molten silver—viz., scintillation and spitting while in the molten state.

**New Electro-Magnetic Apparatus.**—A. Demoget.

**Description of an Apparatus for Registering, by Photography, the Reading of the Barometer.**—P. Volpicelli.

**Historical Notes on the Radiation of Heat from the Moon.**—P. Volpicelli.—After referring to the opinions of Virgil, Dante, Tasso, Marini and Guarini, who denied the possibility of heat emanating from the moon, the author quotes, from the works of Aristotle, Aquino, Pic de la Mirandolle, and Cardan, who, although not enabled to prove, experimentally, any facts relating to this matter, yet admitted that heat emanated, to some degree, from the moon. Dr. Hooke was the first who called attention to this subject, by some observations and experiments; and Geminio Montanori (born, 1632; died, 1687) states, in his "L'Astrologia Convinta di Falsità," that the heat emanating from the moon can be readily made perceptible by means of a large air thermometer and a powerful lens. In our days, the author says, it was Melloni who, on the 23rd of March, 1846, has incontrovertibly proved, by experiments, that the moon radiates heat.

**Double Crystals Exhibited by Snow.**—J. Girard.

**Action of Green Light upon the Mimosa Pudica.**—P. Burt.—The plants are placed under glass jars constructed of variously-coloured glass. The chief fact observed in respect of these very sensitive plants is that, by being covered with a green-coloured glass jar, the plant rapidly becomes insensible, and dies in a very short time.

**Solar Spots Visible by the Naked Eye.**—Tremeschini.—By simply making use of a coloured glass, the author states that these spots can be seen very well; the diameter of the largest was, on the 11th instant at 9 a.m.,  $0^{\circ} 3' 45''$ , and on the 14th at 10 a.m.,  $0^{\circ} 4' 50''$ .

By far the greatest portion of this number is occupied by essays on geometrical, mechanical, and mathematical subjects; and there is no paper strictly relating to chemistry.

*Journal für Praktische Chemie*, No. 16, 1869.

This number contains no original papers.

No. 17, 1869.

**On the Lead Salts of Formic Acid.**—Dr. Barfoed.—The author describes:—Neutral formiate of lead.—According to what is stated on the solubility of this salt in treatises on chemistry, it is soluble in 36 parts of water; but, according to the author's experiments, this salt, prepared with proper care, requires for solution 63 parts of cold water, while it requires  $5\frac{1}{2}$  parts of boiling water for solution. This salt is, moreover, gradually decomposed by being boiled; formic acid escapes, and a basic salt remains. Bibasic formiate of lead is obtained when an aqueous solution of the neutral salt is treated with its equivalent weight of oxide of lead; it is readily obtained in large crystals, which are, however, easily acted upon by the carbonic acid of the air. The formula is  $2\text{PbO}, \text{C}_2\text{H}_3\text{O}_3$ . 1 part of this substance requires 58.5 parts of cold and 10 parts of boiling water for solution; it is insoluble in alcohol, as is likewise the neutral salt. Tribasic formiate of lead is obtained by boiling a solution of the neutral salt with 2 equivalents of oxide of lead; this substance is obtained in small acicular crystals, soluble in  $25\frac{1}{2}$  parts of cold, and  $7\frac{1}{2}$  of boiling water; formula,  $3\text{PbO}, \text{C}_2\text{H}_3\text{O}_3$ . Quadribasic formiate of lead,  $4\text{PbO}, \text{C}_2\text{H}_3\text{O}_3$ .—1 part of this salt requires 104 parts of cold water for solution; it is insoluble in alcohol.

**Estimation of Nitric Acid in Spring Waters.**—Dr. Fleck.—The method, described at great length, is based upon the fact that, according to the author, the nitric acid present in spring waters is chiefly combined with lime or magnesia, and rarely only with alkalis. Use is made of the well-known fact that a solution of sulphate of potassa yields, when mixed with a solution of nitrate of lime, gypsum and nitrate of potassa, which, in its turn, when ignited in the presence of organic substances, is converted into carbonate of potassa; while, lastly, the carbonate of potassa thus formed can be quantitatively estimated and is proportional to the quantity of nitric acid present. The reagents required for the execution of this method are—Normal nitric acid and normal caustic soda solution, each at from 4 to 5 per cent; a solution of sulphate of potassa, 5 grms. to 100 c.c. of water; perfectly pure sugar. According to the statements made in this lengthy essay, this method appears to be a useful addition to quantitative chemical analysis.

**A New Salt from Hallstadt (Austria).**—Dr. Simony.—This mineral occurs along with rock-salt, anhydrite, and a somewhat weathered sulphate of soda; its colour is bluish green; formula,  $\text{MgSO}_4, \text{Na}_2\text{SO}_4, 4\text{H}_2\text{O}$ . This salt is not affected by exposure to air, and loses, even at  $100^{\circ}$ , only a portion of its water. Although, therefore, this salt has the same percentage composition as astrakanite, it has a different constitution. The three now known naturally-occurring double salts of the sulphates of soda and magnesia are, therefore—

$\text{MgSO}_4, \text{Na}_2\text{SO}_4, 4\text{aq}$ , astrakanite, or Bloedite;  
 $2\text{MgSO}_4, 2\text{Na}_2\text{SO}_4, 5\text{H}_2\text{O}, 3\text{aq}$ , Simonyite (the salt just discovered);  
and  $2\text{MgSO}_4, 2\text{Na}_2\text{SO}_4, 5\text{H}_2\text{O}$ , Loewite.

**Synthesis of Hydroxylamine.**—Dr. Ludwig.—The author has succeeded in directly combining nascent hydrogen and deutoxide of nitrogen,  $\text{NO} + \text{H}_2 = \text{NH}_2\text{O}$ . This is effected by passing pure deutoxide of nitrogen through a mixture of tin and hydrochloric acid; the tin is removed by sulphuretted hydrogen, the filtrate is evaporated to dryness, and the residue taken up with alcohol. The chloride of ammonium is removed by chloride of platinum, and the hydroxylamine is precipitated with pure anhydrous ether.

**Action of Chlorine upon Absolute Alcohol while Exposed to Direct Sunlight.**—MM. Streit and Franz.—While engaged in making hydrate of chloral with absolute alcohol, direct sunlight accidentally fell upon the apparatus, the temperature of the contents of which was  $62^{\circ}$ . The continued action of the sun's rays caused a series of sharp detonations, accompanied by very bright lightning-like flashes inside the apparatus; the fluid, previously quite clear, became black, a blackish powder was separated, and the temperature rose to  $78^{\circ}$ . The authors repeated the experiment with artificial light, and found that magnesium light, the light emitted by a mixture of sulphide of carbon and deutoxide of nitrogen while burning, electric light, and the light emitted by the ignition of a mixture of chlorate of potassa and sulphur, when ignited produce the same effect. The products of the decomposition of the alcohol were not further investigated, but exhibited a most frightful stench and a deep reddish brown colour.

*Revue Hebdomadaire de Chimie*, February 10, 1870.

**Process for Rendering Various Substances Waterproof.**—M. Ch. Toppan.—This contrivance consists, essentially, in the employment of a solution of pure paraffin in naphtha—that is to say, light petroleum oil—and to steep the objects required to be waterproof in this solution.

**Estimation of Starch in Bread.**—J. Mayer.—The method proposed by the author is that of converting the starchy matter into glucose, by means of boiling, say 5 grms. of the bread, with water containing 1-20th of its weight of sulphuric acid. The liquid is kept boiling for a considerable time, and from time to time a small quantity is tested with iodine; when, as the latter substance fails to indicate the presence of starch, ebullition is kept up for some time longer, and the glucose which is formed is estimated by Fehling's process. A too weak acid should not be applied, nor, also, a stronger, as both are, according to the author, equally injurious to the accuracy of the results.

**On Diamonds.**—M. F. Rambosson.—This paper, an abstract of a printed book just published, is accompanied by an engraving representing the most celebrated of these precious stones. No mention is, however, made of the largest diamond ever yet found, which once belonged to the Rajah of Mattan, Borneo, but is now in the possession of the Netherlands' Government; this jewel, as yet uncut, however, has a flaw (a very common thing for large diamonds—for instance, the Koh-i-noor), which very materially impairs its value. This stone weighs 367 carats (upwards of 3 ozs. troy), and is egg-shaped.

**Bromoform, Bromal, and Iodal compared with Chloroform and Chloral.**—Dr. Rabuteau.—This paper is the record of some experiments made with these substances to test their anæsthetic value.

*Cosmos*, February 12, 1870.

**Imperial Observatory at Paris.**—By the same decree which relieves M. Le Verrier from his functions as Director of the Observatory, the provisional management and chief control of that establishment is placed in the hands of a committee of three gentlemen—viz., Vice-Admiral Penhoat; M. Combes, Member of the Institute; and M. Balard, Inspector-General of Superior Public Instruction.

**Explosion of a Dynamite Manufactory.**—This took place at Dunwald, near Cologne, a few days ago. The quantity of material exploded was only about 100 kilos.; but the destruction of life and property for a great distance around the spot was such as could hardly have been affected by thirty times as much gunpowder.

**Dangers of Arsenical Green Pigments.**—The Prefect of Police of the Seine (Paris and environs) has very properly issued a notice calling attention to the great danger attending the use of these pigments for imparting colours to the edges of books and various articles of stationery, to which these, specifically, very heavy materials are merely fixed, either by thin glue-water or gum. It is a well-known fact, the police notice says, that, even when mixed with linseed oil, these pigments are liable to become loose and pulverulent (unless peculiar precautions be taken); and they are altogether unsuitable for the purposes just named, since they dust off, and thus may be inhaled and cause derangements of health. The manufacturers of the articles alluded to are, if they continue this practice after this day, amenable to legal proceedings, correctionally as well as *en matière civile* (liable for action for damages).



February 19, 1870.

**University of Heidelberg.**—This, the most ancient of Germany except the Universities of Prague and Vienna, was founded in 1386, and has always been a first-rate establishment and of high standing in physical science. Helmholtz, Bunsen, Kirchhoff, Hofmeister and others have been and are among the bright gems of this scientific institution, which has a teaching staff of 80 men and an average number of from 400 to 600 students.

**Rendering Tissues Waterproof (Imperméables).**—V. Meunier.—1 kilo. of alum is dissolved in 32 kilos. of water, and 1 kilo. of acetate of lead is dissolved in the same quantity (separately) of water. The two liquids having been mixed, there is, of course, precipitated sulphate of lead; as soon as this is deposited, the clear liquid is decanted, and the fabric which it is desired to render waterproof is thoroughly steeped in this fluid, and next dried by being hung up in open air.

*Moniteur Scientifique*, No. 316, February 15, 1870.

This number contains the following original papers and memoirs pertaining to chemistry:—

**Peat from Avigliana, near Turin, Italy.**—Dr. Fino.—Close to the Mont Cenis railway tunnel, in the valley of Susa, an enormous deposit of peat is found which, since fuel of any kind for industrial purposes is scarce all over the Italian soil, is largely used. The authors have analysed four different samples of this fuel, viz.:—The top layer, or light peat, containing, in 100 parts—Water (driven off at 100°), 44.19; volatile combustible matter, 36.44; coke, 16.44; ash, 2.93. Middle layer—Water, 38.10; volatile combustible matter, 36.09; coke, 20.89; ash, 4.92. Lower layer, compact black peat—Water, 32.41; volatile combustible matter, 36.23; coke, 21.22; ash, 10.14. Artificially-compressed very hard black peat—Water, 26.89; volatile combustible matter, 38.38; coke, 22.41; ash, 12.32. The average composition of the ash of these peats (containing, on average, after drying, 11.37 per cent thereof) is, in 100 parts—Silica and clay insoluble in HCl, 37.61; silica soluble in HCl, 0.85; protoxide of iron, 5.30; peroxide of iron, 10.22; alumina, 7.0; lime, 24.61; magnesia, 1.40; sulphuric acid, 3.04; traces of HCl, KO, NaO, and loss, 0.61; carbonic acid, 0.36. The utilisable calorific value of sample 1, in wet state, is 1836; No. 2, 2172; No. 3, 2391; No. 4, 2515.

**Mineral Magnesian Water from Bertinoro.**—M. F. Sestini.—When recently taken from the spring, this water is perfectly limpid, and keeps so in well-corked bottles. When exposed for some time to the air, a white sediment is deposited; taste, bitter saline; exhibits a slight hydrosulphuric odour; does not affect litmus paper, but reddens turmeric paper slightly. 1 litre of the water contains—Chloride of magnesium, 1.71 grms.; chloride of sodium, 7.027; chloride of potassium, a trace; sulphate of soda, 0.368; sulphate of lime, 0.639; bicarbonate of lime, 1.83; alumina, ferrous oxide, and phosphoric acid, 0.016; silica, 0.012; organic matter and ammonia, 0.746;—total, 12.348 grms.

**Ammonia Gunpowder.**—M. A. Jouglot.—The owners of the Nora-Gyttorp Powder Mills, Sweden, have brought out a new kind of powder, which contains, it appears, a mixture of nitrate of ammonia and nitrate of potassa (with what other substances is not said). This material is, according to some accounts, a more powerful explosive than nitroglycerine, and cannot be ignited, or made to explode, but by the impact of a blow, or a falling weight, or by the detonation of a small cartridge containing common gunpowder. Experiments made at a military establishment at Berlin with this powder have proved that, while ordinary gunpowder, gun-cotton, nitroglycerine, and dynamite take fire the moment flame is approached, this powder did not do so. As regards the effect of the impact of a blow of a falling weight (the same, of course, in each case), ordinary gunpowder requires for explosion that the weight falls from a height of between 4 and 5 ft.; nitroglycerine, 1½ ft.; dynamite, 2½ ft.; and ammonia gunpowder, between 12 and 15 ft. A sample having been sent to France from Berlin did not, the author says, confirm the high opinion this substance is thought worthy of in Prussia.

**Waterproofing Paper.**—M. A. Jouglot.—The solution of oxide of copper in ammonia acts, as is well known, as an energetic solvent upon cellulose; this property is made use of to waterproof paper in the following manner:—A tank is made to contain the solution just alluded to, and the paper is rapidly passed just over and in contact with the surface of the liquid, by means of properly-placed rollers moving with speed. The paper, on leaving, is pressed between two cylinders, and next dried by means of so-called drying cylinders, similar to those in use in paper mills. The short contact of the felty paper tissue with the liquid gives rise to just sufficient solution of cellulose to form an impermeable varnish.

*Bulletin de l'Académie Impériale des Sciences de St. Petersburg*, Vol. xiv., No. 3, 1869.

The only paper relating to chemistry in this number is a lengthy one:—

**Chlorinated Derivatives of Toluol.**—Drs. F. Beilstein and A. Kuhlberg.—The authors have divided their memoir into the following sections:—Isomeric tetrachlorotoluols—

$\text{CH}_3\text{Cl}_4\text{CH}_3$ ,  $\text{C}_6\text{H}_2\text{Cl}_3\text{CH}_2\text{Cl}$ ,  $\text{C}_6\text{H}_3\text{Cl}_2\text{CHCl}_2$ , and  $\text{C}_6\text{H}_4\text{Cl.CCl}_3$ ; isomeric pentachlorotoluols—

$\text{C}_6\text{Cl}_5\text{CH}_3$ ,  $\text{C}_6\text{HCl}_4\text{CH}_2\text{Cl}$ ,  $\text{C}_6\text{H}_2\text{Cl}_3\text{CHCl}_2$ , and  $\text{C}_6\text{H}_3\text{Cl}_2\text{CCl}_3$ ; isomeric hexachlorotoluols—

$\text{C}_6\text{Cl}_6$ ,  $\text{CH}_2\text{Cl}$ ,  $\text{C}_6\text{HCl}_4\text{CHCl}_2$ , and  $\text{C}_6\text{H}_2\text{Cl}_3\text{CCl}_3$ ;

isomeric heptachlorotoluols—

$\text{C}_6\text{Cl}_5\text{CHCl}_2$  and  $\text{C}_6\text{HCl}_4\text{CCl}_3$ ,  $\text{C}_6\text{Cl}_5\text{CCl}_3 = \text{C}_7\text{Cl}_8$ .

There is added to this memoir an extensive tabulated review of all the compounds treated of, exhibiting their boiling-point, specific gravity, percentage composition, crystalline shape, melting-point of the solid substances and formulæ.

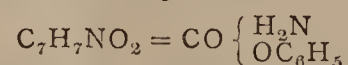
*Berichte der Deutschen Chemischen Gesellschaft zu Berlin*, No. 20, 1869.

This number opens with a beautifully-executed and very good photographic likeness of the late lamented Thomas Graham, represented as he was known to us in the later days of his life. A full biography of the deceased, from the hand of his friend Dr. A. W. Hofmann, forms a conspicuous and valuable portion of this number, which contains the following original papers and communications:—

**Various Reactions Exhibited by the Salts of Oxide of Copper (Black Oxide) when Cyanogen Compounds are Present.**—Ed. Schaer.—This very lengthy paper is reserved for future communication in full.

**Synthesis of Aromatic Acids.**—Th. Zincke.—Referring to the observation of Dr. Wislicenus, that minutely-divided silver is one of the best means for the concatenation (verkettung) of carbon atoms, the author imagined that this might be also useful for the synthesis of aromatic acids. He describes, at very great length, his experiments, beginning with a toluolic acid, phenyl-acetic acid; but, instead of applying silver, use has been made of very minutely-divided copper. The ethyl-ether of the acid just alluded to was heated, along with bromide of benzol and copper, to from 180° to 200°, in a sealed tube. After a lengthy and complicated process of purifying, a sufficient quantity of pure material was obtained to test its properties, which are—A solid crystalline body, fusing at 76°, subliming at a higher temperature, without decomposition, and difficultly soluble in cold, but more readily so in hot, water. The analysis of the silver-salt and the products of oxidation by means of chromic acid, yielding carbonic acid and benzoic acid, prove the perfect identity of the substance as a toluylic acid. **Synthesis of phenyl-propionic acid.**—The author thought that it might be possible to withdraw from monochloro-acetic acid and chloride of benzyl, the chlorine, by means of copper or silver, and to obtain an acid,  $\text{C}_6\text{H}_5\text{CH}_2\text{CH}_2\text{COHO}$ —that is to say,  $\beta$  phenyl-propionic acid; but the results of a series of experiments did not confirm this view; and the body chiefly produced is a substance insoluble in alcohol, whether cold or hot, difficultly soluble in ether, and slightly better soluble in benzol, chloroform, and sulphide of carbon, from all of which solutions it is only obtainable as an amorphous, brittle resin, exhibiting, even in its dilute solutions, a bluish fluorescence similar to that exhibited by solutions of quinine. Energetic oxidising substances are, even at boiling heat, without any action upon this substance, which yielded, by elementary organic analysis, in 100 parts—C, 92.98; H, 6.72; formula,  $\text{C}_7\text{H}_8$ . When chloride of benzyl is diluted with twice its bulk of any hydrocarbon boiling at 130°, and then treated as above described, an aromatic oily substance is obtained, which the author reserves for further investigation.

**Chlorocarbonate and Carbamate of Phenol.**—Th. Kempf.—Referring to his former researches on this subject, the author states that he has obtained a compound—



fusing at 141°; soluble in water, alcohol, and ether; and yielding, on evaporation of these solutions, a crystalline substance; when heated to about 150° with a saturated solution of ammonia in water, phenol is formed, and urea.

**Estimation of the Quantity of Sulphide of Carbon in Coal Gas.**—A. Vogel.—The author first alludes to the great perfection the purifying process of coal gas has attained (at least, abroad, where gas-works are under very severe inspection, and especially so in the country this author hails from—viz., Bavaria), so that coal gas may be made to pass for several consecutive hours through a solution of a lead-salt without affecting it in the least. As to the presence of sulphide of carbon (which, by the bye, the author remarks, owes its formation very much to defective care, in respect of the temperature applied to the retorts, as well as to unsuitable selection of the qualities of coal), it can only be present in small quantity, and therefore its detection, as well as its estimation, become rather more difficult. The plan suggested and experimentally tested is the following, based upon the simple fact that, when pure metallic copper is in contact with gas containing sulphide of carbon, sulphuret of copper is formed:—Coal gas, purposely purified from every trace even of sulphuretted hydrogen, was caused to pass over bright metallic copper for several hours. The surface of the metal having assumed an iridescent hue, the copper was washed with dilute nitric acid; and, a solution of a salt of barium having been added to this acid solution, a precipitate of sulphate of baryta was obtained after some hours' standing. It is, of course, absolutely required to use pure reagents, and insure the freedom of the copper from any sulphur.

**Constitution of Isatine, Isatinic Acid, and Indol.**—Aug. Kekulé.—This paper contains a lengthy hypothetical discussion on this subject in reference to the researches of MM. Baeyer and Emmerling and the author's own.

From the *procès verbal* of the annual general meeting of this Society, we learn that it now numbers 408 members—viz., 137 home and 271 foreign—including a great many Germans resident beyond the limits of the North Germanic confederation. It has extended its corre-



spondents to the chief countries of Europe and America, and possesses an already valuable library, while its financial position is all that can be desired.

*Revue des Cours Scientifiques de la France et de l'Etranger*, February 19, 1870.

This number contains an excellent paper—

Lecture on the Mechanical Forces—M. A. Cazin; but no papers at all relating to chemistry.

*The American Journal of Science and Arts*, January, 1870.

This number contains the following original papers and memoirs relating to chemistry and allied sciences:—

Relation between the Intensity of Light produced from the Combustion of Illuminating-Gas and the Volume of Gas Consumed.—B. Silliman.—This lengthy paper contains valuable information on this subject, and a detailed description of a series of experiments made with a view to prove, among other matters, also this theorem—that the intensity of gas-flames (*i.e.*, illuminating power) increases, within the ordinary limits of consumption, as the square of the volume of the gas consumed. The chief point of interest for the consumer of gas to be deduced from the data here presented is that, where it is important to obtain a maximum of economical effect from the consumption of a given volume of illuminating-gas, this result is best obtained by the use of burners of ample flow.

Principles of Molecular and Cosmical Physics.—W. A. Norton.—A lengthy philosophical essay.

New Method of Separating Tin from Arsenic, Antimony, and Molybdenum.—F. Wigglesworth Clarke.—Reserved for full reprint at a future date.

Contributions to the Chemistry of Common Salt, with particular Reference to Our Home Resources.—C. A. Goessmann.

Account of a Fall of Meteoric Stones near Danville, Ala., with an Analysis of the Same.—J. Lawrence Smith.—This stone fell on Friday, November 27th, 1868, at about five o'clock p.m., at Danville (about lat. 34° 30' N., and long., 87° W. of Greenwich). The iron, separated with great care from the pulverised meteorite, constitutes 3.092 per cent; and, on analysis, furnished—Iron, 89.513; Nickel, 9.050; cobalt, 0.521; copper, a minute quantity; phosphorus, 0.019; sulphur, 0.105. The sulphide of iron, detached very carefully from the mass, gave—Iron, 6.11; sulphur, 39.56. The stony minerals, freed as much as possible from iron and pyrites, contained—Portion soluble in acid, 60.88; insoluble, 39.12. The latter, disintegrated and analysed, gave, in 100 parts—Silica, 50.08; alumina, 4.11; protoxide of iron, 19.85; magnesia, 20.14; lime, 3.90. The analysis of the soluble portion, owing to the unavoidable presence of a little iron and pyrites, furnished results, on analysis, that showed it to be mostly olivine. The soluble and insoluble matter as a whole (freed from pyrites and nickeliferous iron) gave, in 100 parts—Silica, 45.90; protoxide of iron, 23.64; magnesia, 26.52; alumina, 1.73; lime, 2.31; soda, 0.51; potassa, 0.64; sulphur, 1.01; and small quantities (not estimated) of oxides of manganese and chrome, phosphorus, and lithia; the latter detected by means of the spectroscopic.

*Annales des Mines*, No. 5, 1869.

This number contains:—

Critical and Theoretico-Practical Examination of the Heaton Process.—M. L. Gruner.

Some Newly-Discovered and Proposed Processes for the Manufacture of Pig-Iron, Wrought-Iron, and Steel.—M. L. Gruner.

Researches on the Use which can be made of the Offal and Residues of Manufacturing Processes for Agricultural Purposes.—MM. E. Nivoit and E. Létrange.—We regret that we can only quote the sectional titles of this very interesting and lengthy memoir, which is filled with valuable information and a large number of chemical analyses. Residues from glue works; residues from beet-root sugar works; residues from the retting and peeling of flax; residues from breweries; gas-works residues and refuse; refuse from wool; residues and refuse from tan-yards; tallow-melting refuse; sawdust and wood ashes; coal ash; some peculiar mineral ash (*cendres minérales*) from the Ardennes, and their application to mixing with liquid manure. In many instances, full directions have been given for the proper analysis and quantitative estimation of the materials spoken of.

Boring of Shafts by Kind-Chandron's Method at Escarpelle.—M. J. De Boisset.

## NOTES AND QUERIES.

Refractive Power of Saline Solutions.—In *CHEMICAL NEWS*, vol. xiv., p. 156, there is a short note, from *Les Mondes*, "On the Refractive Power of Saline Solutions." Can any of your readers refer me to any recent English work or detailed note on the subject?—P.

Bavarian, Vienna, and Belgian Beers.—Messrs. Zacherl and Degelmeyer.—Munich holy father beer—Sp. gr., 1.03; alcohol, 4.9;

extract, 13.0; carbonic acid, 0.08. Bock beer—Sp. gr., 1.02; alcohol, 4.9; extract, 8.5; carbonic acid, 0.08. Salvator beer—Sp. gr., 1.02; alcohol, 4.2; extract, 8.1; carbonic acid, 1.2. Vienna beer (old)—Sp. gr., 1.012; alcohol, 5.2; extract, 5.0; carbonic acid, 1.5. Vienna double beer—Sp. gr., 1.026; alcohol, 5.2; extract, 7.8; carbonic acid, 1.8. Lambiek, Bruxelles—Alcohol, 4.7; extract, 3.4. Other variety (same name)—Sp. gr., 1.004; alcohol, 5.5; extract, 3.4; carbonic acid, 2.0. Faro beer, Brussels—Sp. gr., 1.005; alcohol, 4.9; extract, 3.0; carbonic acid, 2.0. Brunswick momme—Sp. gr., 1.231; alcohol, 3.6; extract, 4.7; carbonic acid, 1.2. Beer brewed at Utrecht—Alcohol, in 100 parts by volume, 5.4; acetic acid, in 100 parts by volume, 0.016; lactic acid, in 100 parts by volume, 0.35; carbonic acid, in 100 parts by volume, 0.159; extract, in 100 parts by weight, 3.49; ash, in 100 parts by weight, 0.36; albumen, in 100 parts by volume (calculated for 15.5 N), 0.46. Beer from Middelburgh—Alcohol (by bulk), 4.95; albuminous compounds, 0.83; sugar, dextrine, and extract, 3.67; ash, 0.42; lactic acid, 0.26; acetic acid, 0.02; carbonic acid, 0.10.

## MEETINGS FOR THE WEEK.

MONDAY, Feb. 28th.—Royal Geographical, 8.30

London Institution, 4.

TUESDAY, March 1st.—Royal Institution, 3. Dr. Masters, on "Plant Life."

Institution of Civil Engineers, 8.

WEDNESDAY, 2nd.—Society of Arts, 8.

Pharmaceutical, 8.

THURSDAY, 3rd.—Royal Institution, 3. Prof. Odling, "Chemistry."

London Institution, 7.30.

Royal, 8.30

Chemical, 8.

Royal Society Club, 6.

FRIDAY, 4th.—Royal Institution, 8. Mr. Reed, "Iron-Built Ships."

Geologists' Association, 8.

SATURDAY, 5th.—Royal Institution, 3. Prof. Max Müller, "On the Science of Religion."

## TO CORRESPONDENTS.

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*Kalium*.—Perchloric acid is in very small demand. The demand for permanganate of potassium is considerable: Messrs. Condry and Co., Battersea, are the principal makers.

*J. W. S. and others*.—We shall be glad if you will forward replies for "Notes and Queries" in such a form that they can be printed in the Journal. We do not wish a query publicly made to be privately answered.

*James Power*.—A work on the subject by the Editor is in the press.

Professor Charles A. Cameron; Dr. A. W. Hofmann, F.R.S.; H. N. Draper; Dr. Moore; John Pattinson, F.C.S., are thanked for their communications, which shall receive early attention.

## BOOKS RECEIVED.

General-Versammlung der Deutschen Chemischen Gesellschaft zu Berlin am December 11th, 1869. From Dr. A. W. Hofmann, F.R.S.

Annual Report of the Progress of Pharmacy.

Transactions of the Newcastle Chemical Society.

## PRACTICAL CHEMISTRY.

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# THE CHEMICAL NEWS.

VOL. XXI. No. 536.

## ON THE ESTIMATION OF THREE KINDS OF SUGAR IN ONE SOLUTION.

By A. DUPRE, Ph.D.,  
Lecturer on Chemistry at Westminster Hospital.

For some years past, I have been constantly in the habit of estimating two, and sometimes three, kinds of sugar present in one solution, by the conjoint use of the chemical and optical methods. The plan adopted by me differs from that of Professor Apjohn described in the CHEMICAL NEWS (vol. xxi., p. 86), and, I believe, solves the same problem in a more direct manner. This problem is the estimation of cane, grape, and fruit sugar, when present in the same solution. Invert-sugar is a mixture, or compound, of fruit and grape sugar in equivalent proportions, and its amount can therefore readily be calculated if the amount of these two sugars be known.

Now, cane-sugar does not reduce the cupric solution, and is not affected by heating with a dilute solution of caustic alkali. Both grape and fruit sugar, however, reduce the cupric solution, and both are readily destroyed by being heated with a solution of caustic alkali. We can thus estimate the amount of cane-sugar, by its rotative power, having previously destroyed the grape and fruit sugar; we can estimate, chemically, the aggregate amount of these last two sugars, quite independently of the presence or absence of cane-sugar. We have now only to estimate the amount of rotation due to the three sugars jointly, and are then in possession of all the necessary data for the quantitative estimation of each.

It will be seen that the cane-sugar is estimated by direct observation; and the problem thus, in reality, resolves itself into the estimation of a mixture of grape and fruit sugar. The amount of rotation produced by these two being estimated directly, if cane-sugar be absent; indirectly, in the presence of cane-sugar, by subtracting the rotation due to the cane-sugar from the rotation produced by the three sugars jointly.

The instrument employed by me (one of Professor Jellet's beautiful saccharometers) has a 10-inch tube, in which a solution containing—

1 per cent cane-sugar, required for compensation 0.2418 inches left-handed turpentine.

1 per cent fruit-sugar, required for compensation 1.502 inches of a 10 per cent cane-sugar solution.

1 per cent grape-sugar,\* was equivalent to 0.836 inches of 10 per cent cane-sugar solution.

Now, let  $x$  be the amount of fruit-sugar sought; let  $y$  be the amount of grape-sugar sought; let  $p$  be the sum of both sugars found by the cupric solution expressed in percentages; and let  $a$  be the number of inches of 10 per cent cane-sugar solution which has been found to compensate, or be equivalent in rotating power to, the mixture  $p$  of fruit and grape sugar present.

We have then the equations—

$$x + y = p$$

$$x \times 1.502 - y \times 0.836 = \pm a$$

and 
$$x = \frac{p \times 0.836 \pm a}{2.338}$$

$$y = p - x$$

\* I have throughout taken grape-sugar dried at 100°, when its composition is  $C_6H_{12}O_6$ , the same as fruit-sugar.

As regards  $a$ , the sign + is taken if the mixture of the two sugars turns to the left, and requires to be compensated by the cane-sugar solution; the sign −, if the mixture turns to the right; in which case  $a$  represents the number of inches of 10 per cent cane-sugar solution equal in rotative power to this mixture, as estimated by the left-handed turpentine, calculated, of course, in either case, for the 10-inch tube.

I have employed the foregoing method only for estimating the amounts of these three sugars present in wines, but it is, no doubt, equally applicable to crude sugars and syrups.

## THE WATER-TYPE.

By J. ALFRED WANKLYN.

THE following propositions are, I believe, admitted generally at the present time:—

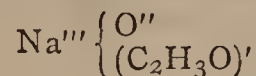
(1). That the oxy-salts of the metals are built on the water-type, and consist of acid-forming radical and metal, bound together by one or more atoms of oxygen.

(2). That an acid is a salt wherein hydrogen plays the part of the metal, being bound by means of oxygen to an acid-forming radical; and that, in like manner, an alkali is a structure wherein hydrogen is bound by oxygen to a metal.

(3). That double decompositions between salts, or between salts and acids or alkalies, or between acids and alkalies, consist in exchanges of one metal for another metal, or for hydrogen. Thus the double decomposition between sulphate of potash and nitrate of baryta is commonly regarded as consisting in an exchange of potassium for barium, whereby sulphate of baryta and nitrate of potash are produced. The same result may be conceived as being produced by the exchange of sulphuryl for nitroxyl ( $NO_2$ ); but chemists do not usually refer these double decompositions to displacements of the acid-forming radicals. The nomenclature which is in use favours the one mode of representation and discourages the other. Thus, keeping to the example above given, chemists of the present day write sulphate of potassium, or potassic sulphate or potassium sulphate and nitrate of barium, baric nitrate or barium nitrate; names which suggest the view that double decomposition takes place by exchange of the metals. The terms potassate of sulphuryl and bariumate of nitroxyl (names which would point to exchange of acid-forming radicals as the *modus operandi* of double decomposition) have, so far as I know, never been proposed by anyone.

As may be gathered from his recent papers, the author of the present notice is prepared to offer other modes of representation, in place of those which have just been set forth, and which are in vogue at the present time.

Instead of looking upon the oxy-salts of the metals as consisting of acid-forming radical and metal held together by oxygen, it is proposed to consider them as being structures wherein oxygen and acid-forming radical are held together by the metal. Thus, quoting from a former paper, acetate of soda is regarded as the following:—

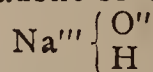


And it should be understood that the considerations which have been urged for the metal sodium and its compounds are taken as being of extensive application, and, with slight modifications, as applicable to the metals in general.

The analogy between acids and metallic salts the author of this notice denies. That the acids are built on the water-type he is, indeed, not prepared to deny; but he maintains that the acids and the metallic salts are built on totally different types. The alkalies, instead of being



waters and being like the acids in structure, are like metallic salts. Thus caustic soda is—



Double decompositions between metallic salts, or between salts and acids or alkalies, or between acids and alkalies, are exchanges of one acid-forming radical for another, or for hydrogen. Such, then, is the contrast between that which is generally received by chemists and that which is proposed as a substitute for it.

These opposite modes of representation are, as a little reflection will show, embodiments of fundamental notions respecting the analogy, or want of analogy, between hydrogen and metals.

The one which is generally in vogue expresses resemblance between hydrogen and metals.

The other, which is proposed, expresses dissimilarity between hydrogen and metals.

Is there, then, as a matter of fact, fundamental analogy, or fundamental want of analogy between hydrogen and metals?

In endeavouring to arrive at a just conclusion on this point, it will hardly be proper to omit mentioning the very obvious facts of the extreme physical dissimilarity of hydrogen to the metals. Whilst hydrogen is the lightest known gas (not liquefied by any degree of cold or of pressure hitherto applied to it), there are metals which figure as the heaviest known solids, and there are metals which have hardly been fused; and all, save one, are solids, under ordinary conditions. There is, moreover, a total want of continuity of physical properties between hydrogen and metals. In volatility, the metal next to hydrogen is mercury; but there is an immense gap between a substance which has not been liquefied and a substance which, like mercury, only ceases to be liquid at 360° C.

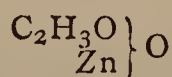
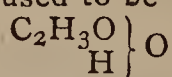
The extreme eagerness with which chemists seize upon the faintest shadow as a pretext for assigning to hydrogen the faculty of existing in a condensed state is, to my mind, evidence of the great importance instinctively allowed to the vast physical dissimilarity between hydrogen and metals which are next of kin to hydrogen according to popular chemical belief.

The facts of the vapour-densities of hydrogen-compounds, and of such metallic compounds as have been investigated in this direction, reiterate the same tale of dissimilarity.

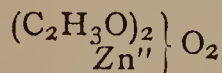
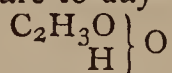
In the standard two volumes of hydrochloric acid gas, there exists only one volume of chlorine; but, in the standard two volumes of chloride of mercury vapour, or chloride of aluminium, or chloride of iron, there are more than one volume of chlorine. The vapour-densities of organo-metallic bodies, moreover, all exhibit more than one volume of organic radical in the standard two volumes of vapour. Up to the present time, no metallic compound has been found to exhibit a vapour-density which should entitle it to figure as a representative of hydrochloric acid gas.

These facts have already exercised a part of their legitimate sway over the theories of metallic structures admitted by the generality of chemists. The old *exact* parallels between salts of hydrogen and salts of metals is no longer maintained in its integrity. Between the formulæ for acetic acid and acetate of zinc we no longer see the ancient all-but-identity.

They used to be\*—



They are to-day—



\* Ten years ago, in commenting on the vapour-densities of metallic compounds, I employed the phrase—Zinc and mercury, regarded as to the densities of their compounds, are to be looked upon as representatives, not of hydrogen, but of oxygen. My own views respecting the structure of zinc compounds have, it is true, undergone development since that time, but still, the train of thought which dictated the phrase is in accordance with my present convictions on the subject.

And, in making proposals for sweeping changes in the notation of metallic compounds, I have not to confront a simple and uniform body of notation, but, on the contrary, the confused and, in many respects, arbitrarily-complex formulæ which are strewn through that deluge of modern text-books of chemistry which has flooded the scientific press.

A comparison of the chemical characters of hydrogen compounds with those of metallic compounds will next be instituted.

One of the chief arguments in support of analogy between hydrogen and metals may be stated as follows:—

For every acid (which is a salt of hydrogen), there exists a whole series of metallic derivatives (salts of the metals); and the properties of salts present a graduated series, in which series the properties of the hydrogen term (or acid) constitute a sort of natural first-term.

In criticism, it may be urged that, although there cannot be an acid and no corresponding salts (for the definitional reason that we require salts in order to recognise the claim to be regarded as an acid), still the converse does not hold good. We do know salts the acids corresponding to which are non-existent, or, at any rate, have hitherto resisted all attempts to prepare them. Moreover, the case of exceeding stability in the metallic salts, and exceeding fragility in the acid, is of frequent occurrence. One of the most familiar maxims in the practical management of chemical operations is that there is a world of difference between that kind of chemical action which takes place in neutral or alkaline solutions and that which happens in presence of free acid. Solution of chromic acid is an oxidising agent of great potency. Solutions of chromates of the metals are almost destitute of oxidising power. These differences between the properties of the acid and the properties of its salts lead on to the discussion of the question of the series of salts with the so-called salt of hydrogen for its initial term.

The sulphates, for example. Water typists tell us that sulphate of potash is inert, because potassium is so strongly electro-positive as to balance the strongly electro-negative sulphuryl which is bound to it by the intervention of oxygen. Sulphuric acid is energetic, because hydrogen is not sufficiently electro-positive to counterpoise the sulphuryl.

But the water typists fail to explain how it comes to pass that sulphate of silver is not energetic; for, since silver is unquestionably less electro-positive than hydrogen, the silver-salt should be even less balanced than the hydrogen-salt.

Bearing in mind that the electro-chemical place of hydrogen is, in reality, an intermediate one, hydrogen, being more electro-positive than some metals, and less so than others, it is difficult to see on what principle the so-called salt of hydrogen can be made to occupy the first place in the saline series. Obviously, it would not do to range in series according to volatility. (Mercury comes next to hydrogen in volatility, and yet mercury-salts are not particularly like acids). Neither could an arrangement according to magnitude of atomic weight be attempted; for the properties of salts are obviously not related to the atomic weights of the metals.

In short, though there are gradations of properties among the metallic salts, these gradations are broken in arriving at the so-called salts of hydrogen; and, in addition to those broad and obvious distinctions between acids and salts which have arrested the attention of chemists ever since chemistry began to be cultivated, there is a fundamental dissimilarity that is at least as broad as that which lies on the surface of the subject.

Recurring to the statement of the water typists that, for every acid, there exists a whole series of metallic derivatives, I have to remark that this should be carefully distinguished from another statement, viz.:—"For every atom of hydroxyl in a compound, an equivalent of *metaloxy* may be substituted." This latter statement is especially far removed from the truth. By far the greater



part of the hydroxyl, the existence of which is recognised by chemists, is incapable of undergoing even pseudo-replacement by most kinds of metaloxyl. I need hardly refer particularly to the now well-known distinction in organic chemistry between such hydroxyl the hydrogen of which is recognised as being easily replaceable by metals, and such as does not admit of such replacement.

It will not be necessary to do more than allude to the fact that the vast array of compounds of carbon with hydrogen is unrepresented by corresponding compounds of carbon with metals. When zinc was made to unite with ethyl, there did not result a representative of ethyl-hydride, but a representative of ethyl-oxide, which is double. When sodium was made to combine with ethyl, it dragged along with it zinc in union with ethyl, and furnished a representative, not of ethyl-hydride, but of ammonia.

From the foregoing, it appears that there is the utmost fundamental dissimilarity between hydrogen and metals. On a future occasion, I propose to develop the new notation of metallic compounds.

London, Feb. 21st, 1870.

## A NEW THEORY OF THE CONSTITUTION OF METALLIC COMPOUNDS.

By J. ALFRED WANKLYN.

In most recent manuals of chemistry, whilst nitrate of potash is written  $\text{KNO}_3$ , nitrate of baryta is written  $\text{Ba}''\text{N}_2\text{O}_6$ ; nitrate of zinc,  $\text{Zn}'''\text{N}_2\text{O}_6$ , &c. In short, whilst the salts of the alkalies and of silver figure as if they were like salts of ethyl, the salts of barium, calcium, magnesium, mercury, zinc, &c., are made to resemble, in formula, the salts of ethylene. Such being the case, it might be expected that the characteristics of distinguishing alcohol compounds from glycol compounds should be presented by the two classes of metallic salts—for instance, the property of forming a fully-saturated and a half-saturated salt might be looked for in barium compounds. We know, however, of no half-nitrate or half-acetate of baryta; and, speaking generally, although the adoption of the two orders of formula for the two classes of metals is an assertion that monobasic acids form only one salt with an alkali-metal or with silver, and two salts with every such metal as barium, yet chemists do not know that such is the case (as a matter of experiment).

That the present glycol-formulæ for the compounds of barium, calcium, magnesium, &c., should have come into general use, and that there should be next to no experimental support for these formulæ, is a most extraordinary thing, and speaks volumes for the depressed state of our chemical conservatives.

The reasons for the adoption of glycol formulæ in the instance of certain metals were partly some very doubtful deductions drawn from the specific heat of the metals, and mainly considerations of the vapour-density of certain metallic compounds.

The facts ascertained concerning the vapour-densities of metallic substances are as follows:—

If the atomic weight of mercury be calculated from the vapour-density of metallic mercury, we arrive at the number 100 for the atomic weight of the metal. In like manner, calculating from the vapour-density of metallic zinc, we get 32.5 for the atomic weight of the metal. But, if, instead of operating upon the metal, we take the chloride or the ethyl-compound, and deduce the atomic weights from the vapour-densities of those compounds, we get 200 for mercury and 65 for zinc. In presence of this discrepancy, chemists have elected to receive the values obtained from the chlorides or ethyl-compounds, and to reject those from the free metals. This procedure involves rather startling theoretical consequences.

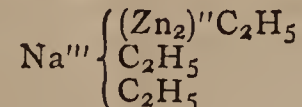
Chemists maintain that oxygen, hydrogen, nitrogen, chlorine, bromine, and iodine, when existing in the free state, exist in the form of molecules, each molecule being formed of two atoms. Chemists maintain, also, that free sulphur, or free phosphorus, or free arsenic exists in the state of molecules, whereof each molecule contains more than two atoms of the element; and, along with all this, chemists maintain that metallic mercury or zinc consists of molecules, whereof each molecule contains only *one* atom of the element. If so vital a distinction existed between the constitution of a free metal and a free metalloid, we ought to find a stupendous difference in chemical or physical properties accompanying these differences in structure. There is, however, nothing very special about metallic mercury or metallic zinc—nothing that should lead to the adoption of extraordinary formulæ for them.

In the new system of notation which I propose, I take the molecule of zinc and of mercury as consisting of two atoms, just as in the case of oxygen, hydrogen, nitrogen, or chlorine; and I take the great density of the vapours of chloride of mercury and zinc-ethyl as proving that these compounds belong to the second rank of mercurial or zinc compounds. The new notation, as a consequence of this mode of treatment, does not require that potash, barium, and zinc salts should be written on radically different types, but restores to the chemistry of the metals much of the simplicity which has been so recently lost.

In two papers published in the *CHEMICAL NEWS* (vol. xx., pp. 293, 313), I gave the new formulæ for the compounds of sodium. I now give the new formulæ for the compounds of zinc—

	$\text{Zn}''' = 32.5$
Free zinc .. ..	$\text{Zn}'''\text{.Zn}'''$
Oxide of zinc .. ..	$\text{Zn}''' \left\{ \begin{array}{c} \text{O} \\ - \\ - \end{array} \right\} \text{Zn}'''$
Hydrated oxide of zinc	$\text{Zn}''' \left\{ \begin{array}{c} \text{O}'' \\ \text{H} \end{array} \right\}$
Nitrate of zinc .. ..	$\text{Zn}''' \left\{ \begin{array}{c} \text{O}'' \\ \text{NO}_2 \end{array} \right\}$
Acetate of zinc .. ..	$\text{Zn}''' \left\{ \begin{array}{c} \text{O}'' \\ (\text{C}_2\text{H}_3\text{O})' \end{array} \right\}$
Sulphate of zinc .. ..	$\text{Zn}''' \left\{ \begin{array}{cc} \text{O}'' & \text{O}'' \\ -\text{SO}_2- & \end{array} \right\} \text{Zn}'''$
Chloride of zinc .. ..	$\text{Zn}''' \left\{ \begin{array}{cc} \text{Cl} & \text{Cl} \\ - & - \end{array} \right\} \text{Zn}'''$
Zinc-ethyl .. ..	$\text{Zn}''' \left\{ \begin{array}{cc} \text{C}_2\text{H}_5 & \text{C}_2\text{H}_5 \\ - & - \end{array} \right\} \text{Zn}'''$
Hydrochlorate of zinc	$\text{Zn}''' \left\{ \begin{array}{c} \text{OH} \\ \text{Cl} \\ \text{H} \end{array} \right\}$

The double compound of zinc-ethyl and sodium-ethyl I write—



From the foregoing, and from these examples, and from those given in my two papers which appeared in the *CHEMICAL NEWS* (vol. xx., pp. 293, 313), it will be perceived that I propose to write the compounds of the so-called "diatomic metals" in the same way as the compounds of the so-called monatomic metals, and that, in fact, I deny that any metal is diatomic. Into the same great class I put potassium, sodium, lithium, caesium, rubidium, thallium, barium, strontium, calcium, magnesium, zinc, cadmium, mercury, manganese, bismuth, antimony, arsenic, phosphorus, nitrogen, and some others. This is the 3, 5, 7 atomic class.

Into class 2 is put tin, iron, aluminium, chromium, and some others. Class 2 is 4-atomic.



All the metals fall into one or other of these two classes. Some of the principles embodied in the new mode of notation are:—

That the metals are fundamentally unlike hydrogen, and that they are eminently polyatomic.

That, most commonly, the metallic chlorides and ethyl-compounds are more complicated in structure than very many other compounds of the metal.

That the hydrated chloride is usually a definite compound.

That double decompositions take place by exchange of the acid-forming radicals of two salts.

On a future occasion, I propose to give examples of the new notation.

London, February 26th, 1870.

## ON MICROSCOPICAL MANIPULATION.

By W. T. SUFFOLK, F.R.M.S.

(Continued from p. 63).

### LESSON I. ON THE USE OF THE CONDENSING LENS AND MIRROR.

#### *Material for Examination—White Blotting-Paper.*

ARRANGE the microscope at a comfortable inclination, and adjust the draw-tubes of the eye-pieces to suit the distance between the eyes. Screw on the objective, *O<sub>1</sub>*; in doing this, hold the glass within the nozzle of the microscope with the first and second fingers of the left hand, while it is screwed in with the finger and thumb of the right. Do not leave go with the left hand until the screws have good hold; observe the same precaution in unscrewing; never risk the fall of an object-glass.

Tear with the forceps (not cut) a minute fragment from the edge of a piece of blotting-paper; place it upon the glass stage-plate, and bring it, as nearly as can be judged, under the centre of the object-glass, which should be well raised above the stage. Place the lamp on the left of the microscope, at a height about half way between the stage and eye-piece, and direct the light upon the paper with the condensing lens (vol. xx., p. 159). Bring the object-glass down, by means of the coarse adjustment, nearly to the working distance of the objective; this is always considerably shorter than the nominal focal length; with *O<sub>1</sub>* it may be a little more than half an inch. After a little practice, the student will learn the proper distance for each glass; until this is acquired, it is best to proceed cautiously, to avoid injury to the object, especially when high powers are used.

Now look through the instrument; adjust the position of the object, with the fingers or stage movements, until it occupies the centre of the field; bring it accurately into focus with the coarse adjustment; and alter the position of the condensing lens and of the lamp, if necessary, so as to obtain the most perfect illumination.

The paper will be found to consist of interlaced fibres, which are seen to the best advantage at the edges, where they are frayed out: hence the direction to tear. This applies in numerous cases, a laceration or fracture sometimes revealing points of structure in a manner not easily demonstrated by other means.

When the object has been fully examined, remove the condenser, open the large aperture in the wheel

of diaphragms beneath the stage, lower the lamp upon its stem into a convenient position for lighting the concave mirror, and direct the convergent pencil upon the object. It will be found that the view now obtained is in every respect inferior to that by reflected light; this is owing, partly to the opacity of the paper, and partly to the different densities of the object and of the medium in which it is viewed. If a higher power, *O<sub>4</sub>, M*, is used, the result will be much worse; this kind of view is that obtained by beginners, who usually try to examine every object by transmitted light, and but rarely use other and better means of illumination. Change the power to *O<sub>1</sub>, B*; place a drop of water on the object with a pipette (or the tip of the finger); cover with a thin glass; absorb any surplus moisture with blotting-paper; replace the slide on the stage; and adjust the focus. The confused appearance of the edges has now disappeared, and the light to some extent penetrates the central portions of the object. With the binocular, the full light from the mirror will be found to produce an unpleasant glare, and the white cloud illumination (vol. xx., p. 265) may be substituted with advantage. Still, little beyond the fibres at and near the edges can be well made out. Remove the slide from the stage; take off the cover, and with a pair of mounted needles tear up and spread out the moistened paper; replace the cover, and examine as before. All the structure will now, probably, be seen; if not, tear the object up still more, until the result is satisfactory. Higher powers may now be used with advantage, taking care to make the requisite correction for the aberration caused by the cover-glass (vol. xx., p. 169), should the objective be provided with the proper adjustment. With the glasses *O<sub>2</sub>*, *O<sub>3</sub>*, and higher powers, it will be desirable to employ the fine adjustment in completing the focussing, and during the observation. Until the beginner has had some experience, it will be best to use *O<sub>2</sub>*, in preference to a higher power, as the risk of damaging the object, or object-glass, is lessened; after a time, the use of glasses of short working distance will become easy. In removing a slide from the stage when a high power is employed, raise the body to some distance, to prevent accidental contact with the front lens, as it might be scratched or otherwise injured.

Try the effect of viewing some more torn up fragments in other media, such as oil, turpentine, or glycerine. Mount a specimen in balsam (vol. xx., p. 207), taking care that the paper has been well saturated with turpentine, to remove air bubbles.

These experiments may be repeated with other kinds of paper, and their different degrees of compactness noticed. The determination of the material of which the paper is composed had better be deferred until Lesson VI. has been studied.

Arrange the microscope and lamp for the use of the condensing lens; as before, use *O<sub>1</sub>, B*; make a few marks, with a soft black-lead pencil, on a piece of blotting-paper, and notice the disposition of the particles of plumbago among the fibres. Examine ink marks; printing from plate (a visiting card will do); likewise specimens of surface-printing, as wood engraving or type, and also lithographs. Notice the varying manner in which the ink is distributed.

Repeat the experiments with the light on the right hand, and also in front. Although it is most convenient to place the lamp on the left, because it is out of the way of the right hand moving and adjust-



ing the object in the stage, yet it may sometimes be required to place the light elsewhere; and the student should be able to work with it in any situation. Practice by daylight should not be neglected whenever opportunities offer.

Try, also, the effect of using different eye-pieces. When a complete series of objectives is not at hand, an awkward interval of magnifying power may often be thus filled up (see Tables, vol. xxi., p. 89). In drawing, it is often useful to make the object fill the field; this can generally be done by a suitable change of eye-piece.

(To be continued.)

## ON THE CONTINUITY OF THE GASEOUS AND LIQUID STATES OF MATTER.\*

By THOMAS ANDREWS, M.D., F.R.S.,  
Vice-President of Queen's College, Belfast.

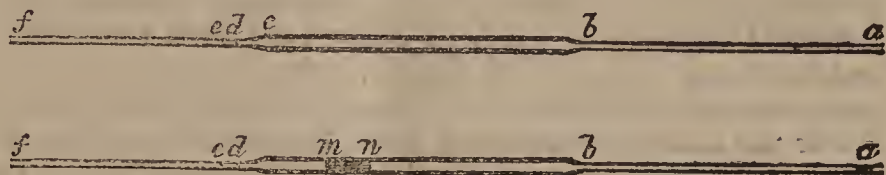
IN 1822 M. Cagniard de la Tour observed that certain liquids, such as ether, alcohol, and water, when heated in hermetically sealed glass tubes, became apparently reduced to vapour in a space from twice to four times the original volume of the liquid. He also made a few numerical determinations of the pressures exerted in these experiments. In the following year Faraday succeeded in liquefying, by the aid of pressure alone, chlorine and several other bodies known before only in the gaseous form. A few years later Thilorier obtained solid carbonic acid, and observed that the coefficient of expansion of the liquid for heat is greater than that of any æriform body. A second memoir by Faraday, published in 1826, greatly extended our knowledge of the effects of cold and pressure on gases. Regnault has examined with care the absolute change of volume in a few gases when exposed to a pressure of twenty atmospheres, and Pouillet has made some observations on the same subject. The experiments of Natterer have carried this inquiry to the enormous pressure of 2790 atmospheres; and although his method is not altogether free from objection, the results he obtained are valuable and deserve more attention than they have hitherto received.

In 1861 a brief notice appeared of some of my early experiments in this direction. Oxygen, hydrogen, nitrogen, carbonic oxide, and nitric oxide were submitted to greater pressures than had previously been attained in glass tubes, and while under these pressures they were exposed to the cold of the carbonic acid and ether-bath. None of the gases exhibited any appearance of liquefaction, although reduced to less than 1-500th of their ordinary volume by the combined action of cold and pressure. In the third edition of Miller's "Chemical Physics," published in 1863, a short account, derived from a private letter addressed by me to Dr. Miller, appeared of some new results I had obtained, under certain fixed conditions of pressure and temperature, with carbonic acid. As these results constitute the foundation of the present investigation and have never been published in a separate form, I may, perhaps, be permitted to make the following extract from my original communication to Dr. Miller. "On partially liquefying carbonic acid by pressure alone, and gradually raising at the same time the temperature to 88° F., the surface of demarcation between the liquid and gas became fainter, lost its curvature, and at last disappeared. The space was then occupied by a homogeneous fluid, which exhibited, when the pressure was suddenly diminished or the temperature slightly lowered, a peculiar appearance of moving or flickering striæ throughout its entire mass.

At temperatures above 88° no apparent liquefaction of carbonic acid, or separation into two distinct forms of matter, could be effected, even when a pressure of 300 or 400 atmospheres was applied. Nitrous oxide gave analogous results."

In the following experiments the gas to be compressed is introduced into a tube, *f, a* (Fig 1), having a capillary bore from *a* to *b*, a diameter of about 2.5 m.m. from *b* to *c*, and of 1.25 m.m. from *c* to *f*. The gas carefully dried is passed for several hours through the tube open at both ends, as represented below. The presence of a column of water

FIG. 1.



of two metres in height was necessary to maintain a moderate stream of gas through the fine capillary tube. In the case of carbonic acid, the gas, after passing through the apparatus, was made to bubble by means of a connecting tube through mercury, and a portion was collected from time to time, in order to ascertain its purity. The current was continued till the residual air, after the action of caustic potash, was reduced to a constant minimum. In repeated trials I found that in the complicated arrangements I had to adopt, the residual air could not be reduced to less than from 1-500th to 1-1000th of the entire volume of the carbonic acid. Even after continuing the current for twenty-four hours this residue appeared; and in discussing some of the results obtained by exposing the gas to high pressures, the presence of this small quantity of air must be carefully taken into account. The capillary end at *a* was then sealed, and the other end was also closed, and afterwards introduced under a surface of pure mercury contained in a glass capsule. The lower end, while under the surface of the mercury, was opened, and heat applied so as to expel a little of the gas. On cooling, contraction occurred, and a short column of mercury entered. The capsule and lower end of the tube were then placed under the receiver of an air-pump, and a partial vacuum was formed till about one-fourth of the gas was removed. On restoring the pressure, a column of mercury entered and occupied the place of the expelled gas. By withdrawing the end of the tube from below the surface of the mercury in the capsule, and again exhausting cautiously, the column of mercury should be reduced to any required length. The tube, when thus filled, had the form shown in Fig. 1.

Two file-marks had been made, one at *d*, the other at *e*, in the narrow part of the tube, about 10 m.m. distant from each other, and the capacity of the tube from a mark near *a* to *d*, and also from the same mark to *e*, had been determined by filling it with mercury at a known temperature and weighing the mercury. The tube was now placed accurately in a horizontal position and connected by an air-tight junction with one limb of a long U-tube filled with mercury. Each limb of the U-tube was 600 m.m. long, and 11 m.m. in diameter. By removing mercury from the outer limb of the U-tube, a partial vacuum was obtained, and the column of mercury, *m, n*, was drawn into the narrow tube, *d, f*. From the difference of capacity of this part of the tube, the column of mercury was now about four times longer than before. It was easy with a little care so to adjust the pressure that the inner end of the mercurial column coincided with the mark *e*. When this was accomplished, the difference of level of the mercury in the two limbs of the U-tube was accurately read by means of a cathetometer, and the height of the barometer as well as the temperature were carefully noted. Similar observations were made with the gas expanded to the mark *d*. Two independent sets

\* The Bakerian Lecture for 1869, delivered before the Royal Society. Communicated to the CHEMICAL NEWS, and revised by the author.

\* Miller's "Chemical Physics," 3rd edition, p. 328.



of data were thus obtained for calculating the volume of the gas at  $0^{\circ}$  C. and 760 m.m., and the results usually agreed to less than 1-1000 part. The tube, after being disconnected with the U-tube, was cut across a little beyond  $e$ , and was now ready to be introduced into the pressure apparatus.

The capillary tubes were calibrated with great care, and their mean capacity was determined by weighing a column of mercury whose length and position in the tube were accurately observed. One m.m. of the air-tube used in these experiments had an average capacity of 0.00002477 c.c., and 1 m.m. of the carbonic-acid tube of 0.00003376 c.c. A table was constructed showing the corrected capacity of each capillary tube from the sealed end for every m.m. of its length. An allowance of 0.5 m.m. was made for the cone formed in sealing the tube.

For the sake of clearness I have described these operations as if they were performed in the detached tube. In actual practice, the tube was in the brass end-piece before it was filled with gas.

The construction of the apparatus employed in these experiments will be readily understood from Fig. 2, which

FIG. 2.



exhibits a section of the simple form. Two massive brass flanges are firmly attached round the ends of a cold-drawn copper tube of great strength, and by means of these flanges two brass end-pieces can be securely bolted to the ends of the copper tube, and the connections made air-tight by the insertion of leather washers. The lower end-piece carries a steel screw, 180 m.m. long, 4 m.m. in diameter, and with an interval of 0.5 m.m. between each thread. The screw is packed with care, and readily holds a pressure of 400 atmospheres or more. A similar end-piece attached to the upper flange carries the glass tube containing the gas to be compressed. The apparatus, before being screwed up, is filled with water, and the

pressure is obtained by screwing the steel screw into the water.

In the compound apparatus (Fig. 3) the internal arrangements are the same as in the simple form. A communication is established between the two sides of the apparatus through  $a, b$ . It is indifferent which of the steel screws below is turned, as the pressure is immediately diffused through the interior of both copper tubes, and is applied through the movable columns of mercury to the two gases to be compressed. Two screws are employed for the purpose of giving a greater command of pressure. In the figure the apparatus is represented without any accessories; when in use it is provided with arrangements for maintaining the capillary tubes and body of the apparatus itself at fixed temperatures. A rectangular brass case, closed before and behind with plate glass, surrounds each capillary tube, and allows it to be maintained at any required temperature by the flow of a stream of water. The body of the apparatus itself, is enclosed in an external vessel of copper, which is filled with water at the temperature of the apartment. This latter arrangement is essential when accurate observations are made.\*

The temperature of the water surrounding the air tube was made to coincide, as closely as possible, with that of the apartment, while the temperature of the water surrounding the carbonic acid tube varied in different experiments from  $13^{\circ}$  C. to  $48^{\circ}$  C. In the experiments to be described in this communication, the mercury did not come into view in the capillary part of the air-tube till the pressure amounted to about forty atmospheres. The volumes of the air and of the carbonic acid were carefully read by a cathetometer, and the results could be relied on with certainty to less than 0.05 m.m. The temperature of the water around the carbonic-acid tube was ascertained by a thermometer carefully graduated by myself according to an arbitrary scale. This thermometer was one of a set of four, which I constructed some years ago, and which all agreed so closely in their indications, that the differences were found to be altogether insignificant when their readings were reduced to degrees.

The general form of the curves representing the changes of volume in carbonic acid will hardly undergo any sensible change from the irregularities in the air-tube; nor will any of the general conclusions at which I have arrived be affected by them. It must, however, always be understood that when the pressures are occasionally spoken of as indicated by the apparent contraction of the air in the air-gauge, the approximate pressures only are meant.

To obtain the capacity in cubic centimetres from the weight in grammes of the mercury which filled any part of a glass tube, the following formula was used,

$$C = W \cdot \frac{1 + 0.000154 \cdot t}{13.596} \cdot 1.00012,$$

where  $C$  is the capacity in c.c.,  $W$  the weight of the mercury which filled the tube at the temperature  $t$ , 0.000154 the coefficient of apparent expansion of mercury in glass, 13.596 the density of mercury at  $0^{\circ}$ , and 1.00012 the density of water at  $4^{\circ}$ .

The volume of the gas  $V$ , at  $0^{\circ}$  and 760 m.m. of pressure, was deduced from the double observations, as follows.

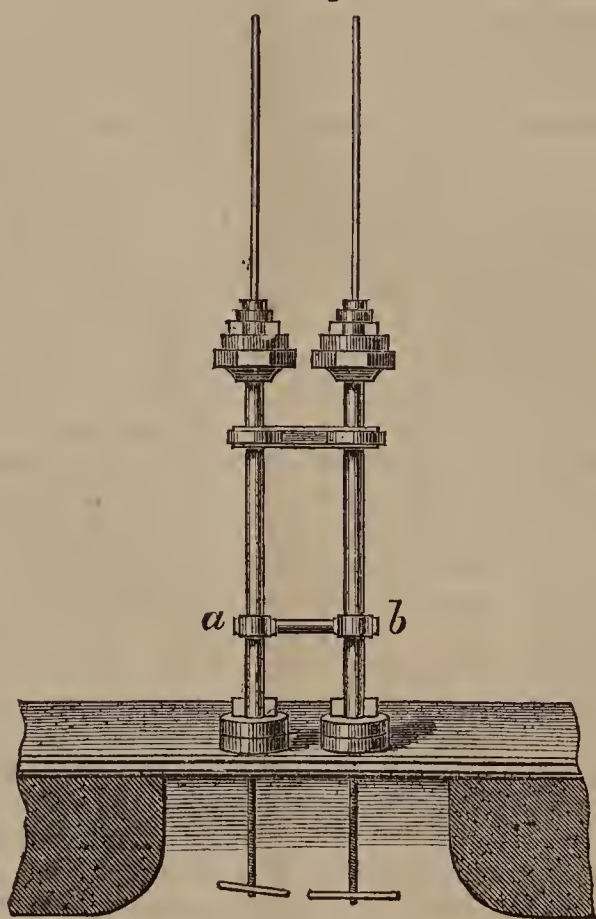
$$V = C \cdot \frac{1}{1 + \alpha t} \cdot \frac{h - d}{760}$$

where  $C$  is the capacity of the tube (Fig. 1) from  $a$  to  $d$ , or from  $a$  to  $e$ ,  $t$  the temperature,  $\alpha$  the coefficient of expansion of the gas for heat (0.00366 in the case of air, 0.0037 in that of carbonic acid),  $h$  the height of the barometer reduced to  $0^{\circ}$  and to the latitude of  $45^{\circ}$ ,  $d$  the difference of the mercurial columns in the U-tube similarly reduced.

Having thus ascertained the volumes of the air and of the carbonic acid before compression, at  $0^{\circ}$  and 760 m.m., it was easy to calculate their volumes under the same

\* In the original memoir a figure is given representing the apparatus with all these accessories.

FIG. 3.





pressure of 760 m.m., at the temperatures at which the measurements were made when the gases were compressed, and thence to deduce the values of the fractions representing the diminution of volume. But the fractions thus obtained would not give results directly comparable for air and carbonic acid. Although the capillary glass tubes in the apparatus communicated with the same reservoir, the pressure on the contained gases was not quite equal, in consequence of the mercurial columns, which confined the air and carbonic acid, being of different heights. The column always stood higher in the carbonic-acid tube than in the air tube, so that the pressure in the latter was a little greater than in the former. The difference in the lengths of the mercurial columns rarely exceeded 200 m.m., or about one-fourth of an atmosphere. This correction was always applied, as was also a trifling correction of 7 m.m. for a difference of capillary depression in the two tubes.

In order to show more clearly the methods of reduction, I will give the details of one experiment.

Volume of air at 0° and 760 m.m. calculated from the observations when the air was expanded to *a e*, 0.3124 c.c.

Volume of same air calculated from the observations when the air was expanded to *a d*, 0.3122 c.c.

Mean volume of air at 0° and 760 m.m., 0.3123 c.c.

The volumes of the carbonic acid, deduced in like manner from two independent observations, were 0.3096 c.c. and 0.3094 c.c. Mean, 0.3095 c.c.

The length of the column of air, after compression at 10.76° in the capillary air-tube, was 272.9 m.m., corresponding to 0.006757 c.c. Hence we have—

$$\delta' = \frac{0.006757}{0.3123 \times 1.0394} = \frac{1}{48.04}$$

But, as the difference in the heights of the mercurial columns in the air-tube and carbonic acid tube, after allowing for the difference of capillary depression was 178 m.m., this result requires a further correction— $\frac{178}{760}$  of an atmosphere—in order to render it comparable with the compression in the carbonic acid tube. The final value for  $\delta$  (the fraction representing the ratio of the volume of the compressed air at the temperature of the experiment to its volume at the same temperature and under the pressure of one atmosphere) will be—

$$\delta = \frac{1}{47.81}$$

The corresponding length of the carbonic acid at 13.22°, in its capillary tube, was 124.6 m.m., equivalent to 0.004211 c.c., from which we deduce for the corresponding fraction for the carbonic acid—

$$\epsilon = \frac{0.004211}{0.3095 \times 1.0489} = \frac{1}{77.09}$$

Hence, it follows that the same pressure which reduced a given volume of air at 10.76° to  $\frac{1}{47.81}$  of its volume, at the same temperature, under one atmosphere, reduced carbonic acid at 13.22° to  $\frac{1}{77.09}$  of its volume, at the temperature of 13.22°, and under a pressure of one atmosphere. Or, assuming the compression of the air to be approximately a measure of the pressure, we may state that, under a pressure of about 47.8 atmospheres, carbonic acid, at 13.22°, contracts to  $\frac{1}{77.09}$  of its volume under one atmosphere.

(To be continued.)

## NOTE ON THE ACTION OF IODINE ON HYPOSULPHITE.\*

By C. R. A. WRIGHT, B.Sc., F.C.S.

In a paper on the valuation of manganese ores, read before the Newcastle Chemical Society, on November 25th, 1869, Messrs. Sherer and Rumpf state that they find

\* Read before the Newcastle-upon-Tyne Chemical Society, February 24th, 1870.

it necessary to titrate the iodine solution obtained by Bunsen's process with standard hyposulphite solution "as soon as possible after the decomposition, since the solution, in presence of air, gradually reacts on the iodide of potassium and liberates iodine;" the iodine solutions in each of two experiments requiring an amount of hyposulphite corresponding to 62.7 per cent of available peroxide in the manganese ore assayed when tested immediately after the decomposition, and to over 65 per cent after standing twenty-four hours; Fresenius and Will's process giving, with the same sample, the intermediate number, 63.5 per cent.

In order to see how far this discrepancy might be accounted for by a possible irregularity in the action of iodine on hyposulphite under different circumstances, as to temperature, &c., a solution of iodine in potassium iodide was prepared of the strength of 5 grms. free iodine to the litre; a solution of pure re-crystallised sodium hyposulphite was also prepared.

Into each of eleven flasks 25.65 c.c. of this hyposulphite was measured by a pipette delivering that amount; about 200 c.c. of water was added to each. In the first flask the quantity of iodine solution requisite to produce a blue tint along with starch, at the ordinary temperature of the air (16° C.) was determined; the second flask was heated to about 60° C., then allowed to cool, and finally titrated as before: almost the same amount of iodine being required, it appears that simply heating the hyposulphite solution does not appreciably alter the quantity of hyposulphite present.

The next eight flasks were heated to varying temperatures, and, while hot, a quantity of iodine solution, rather less than that required for the hyposulphite, as deduced from the first experiments, was added, care being taken to run the iodine direct into the warm liquid, and not down the sides of the flask, which might cause a loss of iodine by volatilisation; no smell of iodine was observed in any case. The addition of this iodine solution slightly cooling the liquids, their temperatures were again read off, the mean of the two temperatures being taken as the average; the warm liquids were then rapidly cooled by immersion of the flasks in cold water, and finally the slight excess of hyposulphite determined by iodine solution; the cooling was essential, since heat destroys the colour of the iodised starch.

The last flask was again titrated at the temperature of the air (16° C.) at the close of the experiments, to make sure that the hyposulphite had not altered spontaneously.

The numbers obtained were—

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
Temperature of solution before addition of iodine solution.. ..	—	—	32	40	52	55	86	88	100	100	—
Do. after .. ..	—	—	28	36	44	46	65	78	83	85	—
Mean temperature .. ..	16 C.	25	30	38	48	50	75	83	91	92	16
C.c. of iodine required .. ..	39.6	39.4	39.8	40.0	40.1	40.1	40.7	40.9	41.4	41.2	39.5
Iodine required in excess of that normally requisite, viz., 39.5 c.c. .. ..	—	—	0.3	0.5	0.6	0.6	1.2	1.4	1.9	1.7	—
Do. in per cents of the normal quantity .. ..	—	—	0.75	1.25	1.5	1.5	3.0	3.5	4.75	4.25	—

From these numbers it is evident that the higher the temperature the larger is the quantity of iodine requisite before a blue colour with starch is developed, *i.e.*, the action of iodine on hyposulphite is slightly irregular at varying temperatures. Since the first action of iodine is to form tetrathionate (which, as is well known, is converted into sulphate by the action of chlorine), it appears probable that the conversion of tetrathionate into sulphate by iodine may account for the excess required. Probably, therefore, if the mode of experimenting were reversed (*i.e.*, hyposulphite added to warm iodine solution, the



latter being always in excess till just the close of the experiment), a greater discrepancy would be manifest. It is difficult, however, to manipulate thus without loss of iodine by volatilisation; but it was found that an excess of iodine added to hyposulphite gradually diminished on standing some hours at the ordinary temperature, *i.e.*, less residual free iodine was found after standing than was present immediately after the addition to the hyposulphite.

Thus, 25.65 c.c. of a rather weaker hyposulphite solution than that previously used was pipetted off into each of ten well stoppered bottles; two were immediately titrated with the former iodine solution, the requisite amount of iodine as thus deduced was added to each of the others; to five of them a varying excess of iodine, and to the remaining three a varying excess of hyposulphite; thus, each of the eight originally contained the same amount of tetrathionate. After standing 24 hours in a cupboard (in the dark) at the ordinary temperature ( $10^{\circ}$  —  $20^{\circ}$  C.), hyposulphite was added in slight excess to the five in which the iodine was originally in excess, and, finally, all were titrated with the iodine solution. The following numbers were obtained:—

	Original excess of Hypo- sulphite.	Original excess of Iodine.	Total Hypo- sulphite used.	Iodine equiva- lent to Hypo- sulphite (deduced from A. and B).	Total Iodine used.	Ratio of Iodine and Hy- posulphite used.
A.* ..	—	—	25.65	—	63.3	2.467
B.* ..	—	—	25.63	—	63.35	2.470
C. ..	—	0.1	26.25	64.8	64.9	2.472
D. ..	—	0.2	26.4	65.2	65.1	2.466
E. ..	—	6.7	28.2	69.6	72.7	2.578
F. ..	—	16.7	31.85	78.6	82.0	2.574
G. ..	—	36.7	37.85	93.6	101.9	2.692
H. ..	1.5	—	27.45	67.8	67.9	2.474
I. ..	5.9	—	31.50	77.8	77.65	2.465
J. ..	9.7	—	35.25	87.05	87.2	2.474

\* Titrated at once.

From these numbers it appears that in the three last experiments there was no action whatever between the tetrathionate present and the excess of hyposulphite; while in experiments E, F, and G, a considerable amount of iodine has *disappeared*, this amount increasing with the original excess of iodine, thus—

	E.	F.	G.
Excess of iodine .. .. .	6.7	16.7	36.7
Iodine disappeared .. .. .	3.1	3.4	8.3
Ditto., in per cents of the normal amount .. .. .	4.4	4.3	8.9

Similarly, in another experiment with the above iodine solution diluted to one-third its former strength, after 24 hours—

Original excess of iodine .. .. .	5 c.c.	13 c.c.
Iodine corresponding to total hypo- sulphite used .. .. .	163.1	164.4
Total iodine used .. .. .	166.7	169.9
Excess of iodine .. .. .	3.6	5.5
Ditto., in per cents of normal quantity .. .. .	2.1	3.3

On the whole, therefore, these experiments indicate that when the temperature is not lower than  $28^{\circ}$  C., or when a mixed solution of hyposulphite and iodine still in excess is allowed to stand some time before finishing the titration, a deficiency in the amount of iodine may be expected, varying in amount with the circumstances: possibly, these facts may account for the results obtained by Messrs. Scherer and Rumpf.

The fact that sulphate is formed by the prolonged action of iodine on tetrathionate is indicated by the following experiments:—50 c.c. of the hyposulphite solution used in the past experiments were mixed with 150 of iodine (large excess); after standing 48 hours at the ordinary temperature in the dark, hyposulphite was added

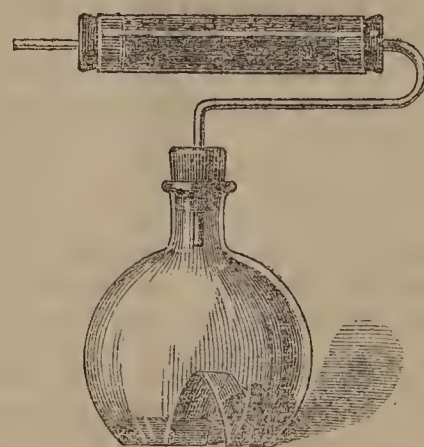
till all free iodine disappeared: chloride of barium gave with this liquid a dense cloud, which, after standing, was collected, and found by the blow-pipe to be really barium sulphate. 50 c.c. of the original hyposulphite with barium chloride gave not the slightest precipitate; after addition of a few drops of hydrochloric acid the solution did not become opalescent for a minute or more; and the precipitated sulphur after standing some hours was wholly volatile, showing that no sulphate whatever was present originally in the hyposulphite.

My best thanks are due to Mr. I. L. Bell, in whose laboratory the above experiments were carried out.

## LABORATORY NOTES.

### NEW APPARATUS FOR THE ANALYSIS OF CARBONATES.

So many forms of apparatus for the analysis of carbonates have been devised that it is just possible the one which is shown in the engraving may have been already suggested.



In Griffin's "Chemical Handicraft," sixteen kinds of apparatus for this purpose are described, but not one of them is of so simple a construction as that which I propose. Fritzsche's is almost as simple as mine, but it is not so manageable.

My apparatus is a light bottle, of the capacity of 75 centimetres. The lower part is divided into two compartments; in one of which the carbonate is placed, in the other the acid. By inclining the bottle, the acid may be allowed to flow over on the carbonate as gradually as the operator pleases. One or two chloride of calcium tubes are inserted through the cork. The cost of this bottle would be about 6d.

CHARLES A. CAMERON, M.D.,  
Analyst to the City of Dublin, &c.

## NOTICES OF BOOKS.

*Reports on the Progress of Practical and Scientific Medicine in different parts of the World.* (For the year beginning June 1st, 1868, and ending June 1st, 1869.) Edited by HORACE DOBELL, M.D., &c., assisted by numerous and distinguished coadjutors. London: Longmans, Green, and Co., 1870. Pp. 645.

IN the preface to this work, the editor asks his readers "to accept this first year's report as a fragmentary hostage of the next; it was only last December that I designed this work, and since that time I have had to open up correspondence with all parts of the world. The design of this work is to bring together in the English language, original and independent reports from all parts of the world, written by distinguished men resident in the countries they represent." As regards the contents of the



work it is a genuine *varietas delectat*. The book opens with a comparative table of weights, measures, &c., and also a table of comparison of the Fahrenheit with the Centigrade and Réaumur's thermometer; the arrangement is alphabetical, and therefore Africa takes precedence. Under this heading we meet with a very valuable record of meteorological observations on the West Coast of Africa, by Dr. J. A. B. Horton, arranged in the following manner:—Atmosphere; Exemption from what Diseases; Predisposed to what Diseases. America, as might be expected, is very well represented, and we learn from the work that this report is the production of a new society just set on foot at New York, for reporting the progress of medicine; and, owing to the embryonic condition of this society, it is not so complete as future reports will be. It is quite impossible to give in a few lines an adequate idea of the large amount of valuable and interesting matter contained in this volume. As an instance of the great variety of matter, we have an excellent paper on "Cider Colic," by J. Buckman; "On the Treatment of Pulmonary Consumption by Ether and Etherised Cod-liver Oil," Dr. B. W. Foster; there are also reports from several European countries, including remote Iceland; but we do not find reports from Russia, Spain, the Netherlands. From the colonies of the latter country there is a report by Dr. Wylie. Taking matters *en resumé*, we have to congratulate the editor on his first production.

## CORRESPONDENCE.

### SHELL SAND FROM THE ISLAND OF COLL.

*To the Editor of the Chemical News.*

SIR,—In the report of my short paper on "Shell Sand" in your last number, there is an error which I beg you will allow me to correct. I did not say that shell sand formed a strong mortar with lime, but that a strong lime was made from it by stacking it alternately with peat, and burning the stack; and that this lime, from the magnesia and silicic acid it contained, was in use almost equal to a cement.—I am, &c.,

EDWARD C. C. STANFORD, F.C.S.

Edinbarnet, Dumbartonshire, N.B.  
February 28, 1870.

[The report was forwarded by the gentleman nominated by the Council to do so.—*Ed. C. N.*]

### THE RASHNESS OF SCIENTIFIC MEN.

*To the Editor of the Chemical News.*

SIR,—Your well-written and excellent contemporary, the *Spectator*, said, last week, that "it seems as if no class of men drew rasher or hastier conclusions than the men of science." This was *apropos* of a recent statement as to the effect of hard and soft water upon the human constitution. Now I should very much like to know who originated this statement. Surely, if a physician, he could not have been a chemist, and, if a chemist, no physician. The *Spectator*, generally intelligent and well-informed, persists, like the *Times*, in speaking of druggists as chemists, and probably shares, too, the popular opinion that a doctor necessarily knows all about analysis and the arcana of chemical science. The investigation of the present case will, I feel confident, result in showing that the rash and hasty conclusion complained of was not drawn by a genuine man of science competent to connect a chemical fact with a physiological phenomenon. There are two many *fungoid* or pseudo-scientific men, who seize upon the results of true philosophers, and misinterpret them to the popular theme.—I am, &c.,

C.

### A NEW DENTISTS' ALLOY FOR STOPPING TEETH.

*To the Editor of the Chemical News.*

SIR,—I have recently examined a new dental alloy which is sold for the purpose of being used as the basis of an amalgam. It occurs in the form of rather coarse filings, nearly white. Warmed in an iron spoon with a little mercury, it soon enters into intimate commixture with it. The warm amalgam, if then pressed in wash-leather in a pair of pincers, loses much mercury, and the dry amalgam thus obtained is ready for insertion into the cavity to be stopped. Its manipulation altogether much resembles that of the celebrated copper amalgam, and it seems to be quite as useful though not so hard. But it possesses this advantage over the copper amalgam (which darkens greatly) that the new amalgam retains its whiteness in the mouth. On analysis the original metal as sold gave:—

Tin .. .. .	61.12	per cent
Silver .. .. .	38.76	" "
Copper, &c., .. ..	0.12	" "
	100.00	

I am, &c.,

C.

### MEMORIAL OR MONUMENT?

*To the Editor of the Chemical News.*

SIR,—It is reported that the Faraday Memorial, for which about £1400 has been subscribed, is to take the form of a "Monument in the British Museum." I hope the report is not authentic. The project is inappropriate, useless, almost ludicrous. Faraday hated monuments, and the British Museum, which has no department of chemistry or physics, is about the last place where one would expect or wish to see a statue of our great natural philosopher. The best memorial for a great worker would be the creation of a reward or stimulus for further work. Why not found a Faraday Scholarship, or award annually a money grant and medal for a great discovery in chemistry or physics? Whatever be done should be in connection with the Royal Institution, the scene of Faraday's life and labours. The experience of the Wollaston Fund which is connected with the Geological Society, affords an excellent precedent for the present case. Our English experience in busts and statues (especially when posthumous) is not so happy as to encourage us to risk an additional failure.—I am, &c.,

A SUBSCRIBER TO A MEMORIAL,  
NOT A MONUMENT.

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

*Under this heading will be found an encyclopaedic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

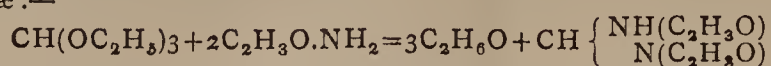
*Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 1*  
1870.

This number contains the following original papers and memoirs:—

A Base Isomeric with Hydrocyanide of Ammonia (Cyanwasserstoff-Ammonia).—H. Wichelhaus.—When orthoformic acid ether and acetamide are heated in a sealed tube for some hours to 180°, there is formed along with alcohol a white-coloured crystalline



substance, the origin of which is explained by the following formulæ:—



This substance is methenyl-diacetyl-diamine. Another product of this reaction is a substance the platinum salt of which is—

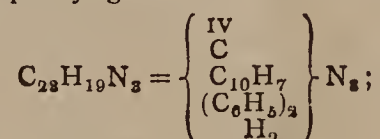


while the base itself is  $\text{CN}_2\text{H}_4$ , termed by the author amidomethenylimide, and found to be isomeric with hydrocyanide of ammonia.

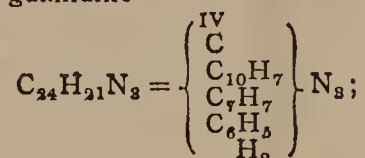
**Terchloride of Iodine.**—Jul. Philipp.—The terchloride of iodine does not behave with reagents as the other terchlorides do; treated with alkalis, it does not yield iodous acid (*jodige säure*), but iodic acid, while iodine is set free. This, according to the author, is due to the fact that  $\text{ICl}_3$  is not a simple molecule, but a juxtaposition of  $\text{ICl}$  and  $\text{Cl}_2$ ; and this is proved by the behaviour of the terchloride of iodine with reagents. These reactions are described at very great length, but space forbids to enter into more details.

**Manufacture of Sulphuric Acid.**—A. W. Hofmann.—The use of the nitric acid in the manufacture of sulphuric acid is to transfer the oxygen of the air on to the sulphurous acid; and, theoretically, therefore, a given quantity of nitric acid ought to convert an unlimited amount of sulphurous into sulphuric acid. That this is not obtained in practice can hardly be wondered at, since no manufacturing processes can be conducted absolutely without loss; but the loss of nitric acid in the manufacture of sulphuric acid, even when proper care is taken to ensure good working of the chambers, is so large that the inference is quite justifiable that there are peculiar chemical reactions at play. The study of these reactions has occupied the author, who states that, although he has not solved the problem entirely, he has obtained results worth communicating. When sulphurous acid is caused to pass into nitric acid which contains some sulphuric acid (sp. gr., 1.676 to 1.714), the nitric acid is converted into compounds which form, along with the sulphuric acid present, the so-called chamber crystals, without any perceptible formation of protoxide of nitrogen; but, when the nitric acid is impregnated with a sulphuric acid (sp. gr., 1.532), and the experiment just alluded to repeated, there is formed a considerable quantity of nitrogen, which is, of course, quite as injurious to the process as the presence and formation of protoxide of nitrogen. The explanation of this phenomenon is the insufficient strength of the sulphuric acid to form, in combination with the higher degrees of oxidation of nitrogen, the so-called chamber crystals. This having been ascertained, the author applied his knowledge of these facts in the following manner on the large scale:—The quantity of steam admitted to the first chamber (the so-called Tambour) was so regulated as to produce acid only at 60° Beaumé (sp. gr., 1.714 = 1.43° Twaddle), with the striking result, fully confirming the laboratory experiment, that a far smaller quantity of nitric acid was required for the same production of sulphuric acid. The author adds, that if, by accident, the strength of the acid in the aforesaid chamber should fall below the sp. gr. just alluded to, it can be easily brought up to that strength by the addition of acid of 66° Beaumé (sp. gr., 1.847) = 1.69 Twaddle. By this contrivance, it is possible to manufacture sulphuric acid with a consumption of only 1 lb. of nitric acid for 100 lbs. of sulphur burnt.

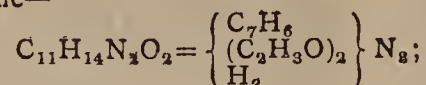
**Derivatives from Guanidine.**—F. Tiemann.—The author describes—Naphthylidiphenyl-guanidine—



naphthyltolylphenyl-guanidine—



diacetolylendiamine—



and treats, at great length, of the preparation and complicated reactions by which these substances are obtained.

**Ethyl Combinations of Thallium.**—C. Hansen.—Thallium-diethyl-chloride,  $\text{Tl}(\text{C}_2\text{H}_5)_2\text{Cl}$ , a solid substance, soluble in boiling water, ether, and alcohol, is affected by light similarly to chloride of silver; slowly heated to 225°, it does not melt, but is charred; rapidly exposure to heat causes its instantaneous decomposition, accompanied by explosion, yielding a mixture of ethylen, ethylic hydride, and chloride of thallium; this decomposition ensues, therefore, according to the formula  $\text{Tl}(\text{C}_2\text{H}_5)_2\text{Cl} = \text{TlCl} + \text{C}_2\text{H}_4 + \text{C}_2\text{H}_6$ . Sulpho-thallium-diethyl,  $(\text{Tl}[\text{C}_2\text{H}_5)_2]\text{SO}_4$ , also a solid substance, crystallising in a foliated mass, soluble in water, ether, and alcohol. Nitro-thallium-diethyl,  $\text{Tl}(\text{C}_2\text{H}_5)_2\text{NO}_2$ , a solid body, very readily decomposable by heat.

**Silico-Propionic Acid.**—C. Friedel and A. Ladenburg.—A lengthy and exhaustive monograph.

**Contribution to Explain Chemical Phenomena according to Mechanical Principles.**—Dr. J. W. Gunning.

**Appendix to the Researches on the Guaiacum Copper Reaction.**—Ed. Schaer.—This is a supplementary part to the author's researches on this subject as detailed in the foregoing number of this periodical, but not suitable for abstraction.

**Regressive Formations (Regressiv Bildungen) by Tri-Substituted Guanidines.**—V. Merz and W. Weith.

**Diamines Derived from  $\alpha$  and  $\beta$  Dinitronaphthalines.**—A. de Aguiar.—This paper, and the immediately foregoing, are too lengthy and too full of formulæ and diagrams to admit of any useful abstraction.

**Researches on Xantho-Cobalt, Roseo-Cobalt, and Purpureo-Cobalt.**—W. Gibbs.—The author states that, as an addition to his researches on xantho-cobalt, he has discovered the roseo- and purpureo-cobalt; the chloride of xantho-cobalt,  $\text{CO}_2(\text{NO}_2)_4\text{Cl} + 4\text{NaCl}$ ; chloride of purpureo-cobalt,  $10\text{NH}_3\text{CO}_2\text{Cl}_6 + 4\text{NaNO}_2$ . The memoir is an accumulation of formulæ, some of which are so lengthy that they occupy from two to four lines in print. The paper does not state anything about the origin or preparation of the substances, named along with several others.

**Lecture Experiments.**—J. Schoras.—(1.) *On Some Peculiar Actions of the Sun's Rays.*—When it is desired to prove the reducing action of oxalic acid upon metallic chlorides, it is a well-known experiment to boil a solution of chloride of gold to which oxalic acid solution has been previously added. The lecturer quotes, at the same time, another instance of this kind—viz., that a solution of chloride of mercury (corrosive sublimate), when treated in the same manner, is reduced to subchloride (calomel). When, during the lecture, this experiment is made too hurriedly, for the sake of saving time, the only appearance seen is the feeble turbidity produced by the separation of a mere cloud of calomel; and, even if the boiling is continued for some time, it is readily seen that this reaction is not quite complete. When, however, a solution of perchloride of mercury is, after the addition of oxalic acid, exposed to the action of direct sunlight, the copious precipitation of calomel ensues, after a few minutes' exposure, in the shape of brilliant mother-of-pearl-like scales, which, illuminated by the direct sunlight they are formed by, give rise to a beautiful phenomenon. If this sediment is collected, and dried at 110°, it will be found, on analysis, to contain 15.2 per cent of chlorine, thus proving it to be calomel. This experiment, and the undermentioned, can, however, only be tried in our latitude when the sun is at its zenith, in July. When a solution of Berlin blue in oxalic acid is exposed to the direct rays of the sun, a sudden precipitation of Berlin blue ensues, and, instead of a deep-coloured, almost non-transparent fluid, a perfectly clear colourless liquid is exhibited. It is a well-known fact that solutions of the per-salts of iron and uranium, to which oxalic acid is added, are, on being exposed to direct sunlight, converted to solutions of the protoxides of the metals, while carbonic acid is given off. The perchlorides answer best for experiments; a solution of perchloride of iron, to which tartaric acid has been added, is acted upon in a manner which is not quite explained. Such a solution is used in photography, in the so-called carbon process. A collodion plate, impregnated with the iron solution referred to, and dried in the dark, obtains, on exposure to light, the property of retaining, energetically, at the portions affected by the light, finely-divided substances—as, for instance, powdered black-lead, English red, finely-divided metals, and metallic oxides. The quantity of the powders thus adhering depends upon the greater or lesser intensity of the light which has fallen on it; and it is this condition which defines the various depths of hues and shades, and renders the stereometrical representation of the object possible. Photographers say that the action of the light has rendered the salt hygroscopic, and that this property causes the adhesion of the pulverulent substances. Whatever the action may be, the author states that a reduction process is in play. A solution of chloride of iron, to which tartaric acid had been previously added, and the colour of which was deep yellow, became, when exposed to direct sunlight, quite colourless; an evident proof that reduction had taken place. When a solution of peroxide of iron in tartaric acid is exposed to direct sunlight, a copious sediment of a crystalline yellowish green-coloured substance is thrown down. Since reduction takes place here on the one hand, oxidation must take place, of necessity, on the other; but it is not accompanied by any evolution of gas. The author reserves further study and experiments on this subject, which, as he very properly observes, may throw light upon many processes going on in animal and vegetable life. (2.) *Peculiar Phenomena of Colouration Exhibited by Some of the Platino-Cyanides.*—Gmelin was the first discoverer of potassium platino-cyanide; MM. Quadrat and Schafarik obtained similar compounds afterwards. We owe to Dr. Martius a valuable and exhaustive work on these substances and their composition. It is well-known that many of these salts are remarkable for a strong di- and tri-chroism; and this induced the author of this paper, while preparing a series of these salts, to make some very curious observations thereon, which are described as follows:—The calcium and magnesium salt of this series lose their water of crystallisation completely at a comparatively low temperature, and take it up again on cooling with great ease and rapidity. The anhydrous salts are white—the hydrated are coloured; therefore, paper and other suitable materials impregnated with solutions of these salts, become coloured. But a slight elevation of temperature is sufficient to decolourise them; and, on cooling, the colour reappears, in consequence of the more or less ease and rapidity wherewith the water of crystallisation is taken up. A slip of paper impregnated with a solution of magnesium platino-cyanide, exhibits, after drying, a beautifully bright red colour. A slight elevation of temperature is sufficient to render the salt anhydrous, and to temporarily destroy the colour entirely, which, however, reappears on cooling; while the re-taking up of the water may be aided by breathing over the paper. A slip of paper impregnated with a solution of calcium platino-cyanide exhibits, after drying, a bright canary-yellow colour; on being warmed, dehydration of the salt takes place, and, consequently, its complete decolouration; removal from the source of heat, accompanied by gentle breathing over the paper, is sufficient to restore the colour. When these experiments are made at night-time, magnesium light should be employed to render



the true colours (especially the yellow) properly visible. The barium salt is also yellow-coloured, but is not so sensitive for the purpose as the calcium salt. When a mixture of the solution of the barium salt along with the potassium salt of this series is taken for the purpose of impregnating paper, that material exhibits, after drying, an unsightly yellow colour, which has the property of changing, by gently heating, from yellow to orange and red; and if the heat be increased, the original colour returns. While cooling, the piece of paper impregnated with the salt exhibits the phenomenon of passing through the same series of shades of different colours already alluded to—viz., yellow, orange, red, and again whitish yellow, the original colour. The lithium platino-cyanide is deliquescent, and hence unsuited for any experiments of a similar nature; the ammonium salt exhibits, while being evaporated to dryness on a porcelain basin, most curious brown-red colourations. The author suggests that if, while experimenting with these impregnated slips of paper in a lecture-room, any of them become ignited and burn to ash, this should be taken upon the feather of a quill, and immediately removed to a jar containing a mixture of oxygen and hydrogen (in the proportions to form water), and thus show the action of the spongy platinum left in the ash. The slips of paper impregnated with the calcium salt may, after having been previously decoloured by the application of heat, be very suitably applied for the detection of the least trace of moisture, since that has the effect of at once restoring the yellow colour. The author particularly points out that, since all the salts here spoken of are most violent poisons, they should not be used, or experimented with, but by parties who can be trusted with such matters; fortunately, also, the preparation is an expensive operation, as well as one requiring great skill and more knowledge than is common with those who usually undertake the preparation of chemical substances for sale as amusing toys.

*Bulletin de la Société Chimique de Paris, January, 1870.*

From the *procès verbaux* of the meetings of the Society, we learn that M. J. Gautier gave a brief communication on the following questions:—Is the temperature at which two gases combine invariable? What influence is exerted by the products of their mutual reaction? What influence is exerted by any impurities purposely added? The author states that he is engaged in researches to answer these questions, and gave the following account of the results hitherto obtained:—A mixture of 2 volumes of hydrogen and 1 of oxygen having been made, this was exposed to incipient red heat, when it was found that union of the two gases takes place without being attended by any explosion. When heated by means of a Bunsen gas burner, union takes place instantaneously; and at an intermediate temperature between the first and last-named, union takes place rapidly, but without any explosion. Oxide of carbon unites with oxygen below red heat visible by daylight; chlorine and hydrogen, placed in absolutely opaque and sealed tubes, begin to form chlorhydric acid at 190°, and at 200° the combination becomes rapid. M. J. Friedel communicates that he has obtained oxide of amyl by heating, to 200°, amylic alcohol with one-tenth of its weight of iodide of amyl. The products of the reaction are—Water, amylen, amylic alcohol (mixed with some iodide of amyl and oxide of amyl; the latter in quantity of about one-third of the alcohol employed. Dr. Prinvaux states that, when he made bromine act upon protochloride of phosphorus, a brownish coloured oil was obtained, boiling at 75°; this liquid was found to consist of a fluid,  $PBr_3 + 3ClBr$ , and a solid substance deposited on cooling in prismatic crystals,  $PBr_3 + 2ClBr$ . When protochloride of phosphorus is made to act on bromine, a solid substance, fusing at 45°, and crystallising in oblique prisms, is obtained; formula,  $PCl_3Br_4$ . Heat decomposes these, yielding the protochloride and  $PCl_3Br_8$ .

The following papers and memoirs were read or deposited:—

**Relation Existing between the Variation of the Crystalline Shape of Alum and the Menstruum it is Crystallised from.**—E. Janettaz.—After referring to the labours of MM. Weber and Bendaud Lévy on this subject, the author describes a series of experiments made with the view of eliciting answers to the following questions:—Does the menstruum affect the composition of the crystals of alum? Are the isomorphous alums influenced in the same way by identical conditions? Is the action of acids isomorphous with hydrochloric acid the same? Supposing an alum to have been modified by hydrochloric acid, to be next dissolved by water, does the hemiedric condition remain? Is the complex form exhibited by these substances the result of all the bodies simultaneously in solution with them? Is any free acid required for the purpose of imparting to these substances a peculiar crystalline form? The lengthy memoir is rather a crystallographical essay.

**Researches on the Action of Oxychloride of Carbon upon the Carbides of Hydrogen.**—Dr. Berthelot.—In the introduction to this memoir, the author says that, while experimenting with oxychloride of carbon, he found, to his surprise, that this gas does not possess the chemical activity commonly attributed to it of late. This discovery induced him to repeat Harnitzky's experiments on the synthesis of organic acids, by causing the oxychloride of carbon to react upon carbides of hydrogen. The author states that, notwithstanding every exertion made by him, he did not succeed in obtaining any of these substances; and relates, at great length, what reactions, if any at all did take place, between the oxychloride and marsh-gas; acetylen and benzol; oxychloride, with excess of chlorine; nascent oxychloride and an impure oxychloride; and the same hydrocarbides.

**History of Oxychloride of Carbon.**—Dr. Berthelot.—The most salient part of this paper is that, when oxychloride of potassa is placed in contact with slightly-damped bicarbonate of potassa, the volume of

the gas increases three-fold, and is still completely absorbed by caustic potassa—



**Analyses of Mixtures of Gases Containing Oxychloride of Carbon.**—Dr. Berthelot.—Suppose a gas mixture to contain chlorine, oxychloride of carbon, oxide of carbon, oxygen, and nitrogen. Shake the mixture first with some mercury, to remove the chlorine; caustic potassa solution removes oxychloride; pyrogallate of potassa removes oxygen; protochloride of copper removes oxide of carbon. Let the mixture contain—Oxychloride of carbon, hydrochloric acid, carbonic acid, oxide of carbon or carburetted hydrogens, oxygen, and nitrogen. Mercury is applied for the removal of chlorine. One single drop of water dissolves and takes the hydrochloric acid, without affecting either the oxychloride or carbonic acid; one single drop of absolute alcohol first dissolves the oxychloride, converting it into an ether which, along with any vapour of alcohol, is removed by a drop of concentrated sulphuric acid. The residue is treated by a single drop of a concentrated solution of caustic potassa, which takes up carbonic acid; the oxygen is removed by pyrogallate of potassa, the hydrocarbides by bromine, and the oxide of carbon by protochloride of copper.

**On Chloride of Acetylen, and on the Synthesis of Julin's Chloride.**—Drs. Berthelot and Jungfleisch.

**Action of Hydrate of Potassa upon the Sulphuric Acid Derivatives of Hydrocarbons.**—Dr. Berthelot.

**Synthesis of Acetic Acid from Acetylen.**—Dr. Berthelot.—These three papers have appeared in a condensed state in the *Comptes Rendus*, and were noticed by us.

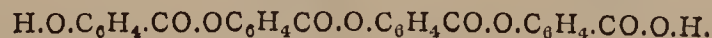
**Products of the Condensation of Valeric Aldehyde.**—J. Riban.—The author states that his chief object is to say that, while M. Borodine has preceded him in the publishing of results obtained on this subject (see *CHEMICAL NEWS*, vol. xx., p. 286, quoted by J. Riban), he reserves to himself the right of giving his experiments, as made at a date anterior to M. Borodine's, whose researches he confirms as correct.

**Salicilonitrile.**—E. Grimaux.—A continuation of a former paper.

**On Phenate of Isopropyl and some Bromated Derivatives.**—R. D. Silva.—Phenate of isopropyl,  $C_6H_5(CH_3-CH-CH_3)O$ , is a colourless, somewhat viscous liquid, smelling like essence of geranium; boils at 176°; sp. gr. at 0°, 0.958; refraction index, 1.5124; vapour density, 4.73. Monobromated isopropyl,  $C_6H_4Br(CH_3-CH-CH_3)O$ , a colourless, rather viscous liquid, insoluble in water, soluble in alcohol and ether, and boiling at 236°; sp. gr. at 0°, 1.981. Perbromated phenate of isopropyl, a solid substance fusing at 95°.

**Bromotoluen and Paratoluidine.**—O. Wallach.—The main object of this paper is a rectification of errors committed, according to the authors, at least, by M. Rosensteihl, who stated that the author had mistaken a mixture of pseudo-toluidine and toluidine for a bromotoluen.

**Letter from M. Kraut to the Editor of the "Bulletin," Requesting Correction of some Abstracts from M. Kraut's Paper on Salicylic Compounds.**—A brief notice, the greater portion of which is occupied with formulæ—e.g., trisalicylosalicylic acid—



*Annales du Genie Civil, January, 1870.*

This periodical rarely contains original papers on chemistry and allied sciences; but this number contains a paper on—

**Soap and Soap Making.**—L. Droux.—Divided into several sections. Introduction; from what time, or period, does the making of soap date? soap was known to the ancients; soap making at Marseilles in the 17th century; artificially-made soda, vegetable oils, and oleic acid; distribution of the soap-works over Europe; soft soap unknown and never used in southern countries; legislative enactments, as regards soap and the fiscal duties thereon; statistical review of the importance of the soap manufacture in France, the United Kingdom, and other European countries. This is simply the skeleton of the contents of this, in many respects, very important paper. Soap, the author proves, was known to the ancients at a very remote period, but its manufacture was not generally well understood. It appears we are in Europe indebted to the Saracens for the re-discovery of the manufacture of soap, as much as for the discovery of the manufacture of paper, sugar refining, and other industrial arts.

*Zeitschrift für Chemie von Beilstein, No. 3, 1870.*

This number contains the following original papers:—

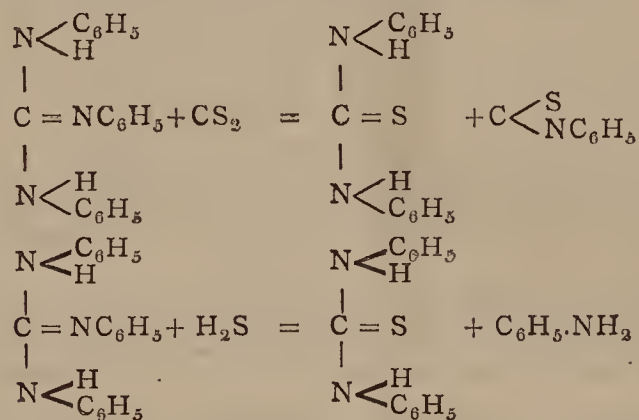
**Formation of Ozone During Active Combustion.**—O. Loew.—After referring to the well-known instances of the formation of ozone during slow combustion and oxidation, the author gives the opinion that every act of oxidation, whether slow or more rapid, is accompanied by the formation of ozone just previous to the combination between the substance to be oxidised and the oxygen converted into a state of great activity taking place. The following experiment is described to prove this dictum:—A current of air is blown through a rather wide glass tube towards the flame of a Bunsen gas burner; and opposite the end of the tube, which is directed towards the flame, a suitably-sized beaker-glass is held; and after a few seconds, the blowing is discontinued, and the beaker-glass simultaneously covered with a glass plate. When the air contained in the beaker-glass is tested, it will be found to emit the peculiar odour of ozone, to blue



guaiacum paper, and to separate iodine from iodide of potassium. The formation of ozone is greatest when the current of air is so strong as nearly to cause the extinguishing of the flame. The experiment succeeds with every other kind of flame, provided care be taken so to regulate the current of air as to exclude the presence of intermediate products of combustion, as, for instance, vapours of partly-consumed alcohol, if a spirit-flame be used. The author draws from his researches the following conclusions:—(1) Oxygen is first converted into ozone in every case where active combustion takes place. (2) Far more ozone is formed than is required for the keeping up of the process of complete combustion and oxidation of the oxidisable material. This surplus of ozone is, in all ordinary cases of combustion, destroyed, partly by the high temperature, and partly by the rush of cold air, and draught thereby caused, attending the combustion.

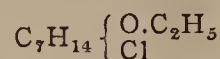
**Dissociation of Fluid Sulphuric Acid, and on a General Method of Estimation of the Degree of Dissociation of a Fluid Compound.**—L. Pfaundler.—The author first briefly refers to W. Dittmar's paper on this subject, and next gives a lengthy tabulated form, exhibiting the results of his researches on the dissociation of sulphuric acid, finishing his paper with a number of algebraical formulæ suitable for the calculation of the degree of dissociation of any fluid compound.

**Regressive Formations (Regressiv Bildungen) of the Tri-Substituted Guanidines.**—V. Merz and W. Weith.—It is rather to be regretted that the authors of this paper have not commenced it by giving a concise explanation of what they understand by regressive formations, which is not at all clear from the contents. Sulpho-carbanilide is decomposed (so the paper begins), by the action of heat, into triphenyl-guanidine, sulphide of carbon, and sulphuretted hydrogen. From the further contents and description of experiments, it would appear that, by regressive formation, is meant a regeneration of a substance—say, sulpho-carbanilide—while being heated, so that, instead of its entire decomposition as final result, there is found a large quantity (the authors mention even 90 per cent) of the substance unacted upon by heat. The chief illustration given of what is understood by the regressive (better, perhaps, in English, regenerative) process is rendered by the following formulæ, referring to the two reactions by which sulpho-carbanilide can be obtained from triphenyl-guanidine; the formulæ hold good, also, regressively:—



**Note on Oxalate of Silver.**—F. A. Mühlhäuser.—The author says, Drs. Thudichum and Wanklyn stated some time ago, in contradiction to Gmelin, that oxalate of silver is an anhydrous salt; but, however correct the statement of the gentlemen just named may be, it is no novelty at all, having been long since mentioned in the *Annalen der Chemie* (101, 177). The author adds—It would have been of far more value to science if the parties had communicated their mode and means of correctly analysing a salt which is very readily decomposed with explosion.

**Products of Condensation from Oenanthal.**—Hugo Schiff.—About twenty-one years ago, says the author, Dr. Williamson found that a solution of oenanthal in 4 volumes of alcohol, saturated with HCl, yielded, on addition of water, oenanthic ether. The author contradicts this, stating at the same time that Dr. Williamson's oenanthal has been, in all probability, largely contaminated with oenanthic acid, since pure oenanthal, previously saturated with HCl and dissolved in alcohol, separates into two layers, distinctly exhibiting a different specific gravity. The chief product of this reaction is septen-oxyethyl-chloride—



a substance insoluble in water, soluble in alcohol and ether, and becoming gradually decomposed, even by the addition of warm water. This substance is dissociated by distillation, yielding hydrochloric acid, ethylen, chloride of ethyl, steam, a mixture of hydrocarbons, and a couple of oxygenated compounds. The following products of fractional distillation were obtained from the residue of the first distillation, carried on to 320°:—Oenanthylene,  $\text{C}_7\text{H}_{14}$ , boiling-point, 90–100°; a fluid boiling between 245° and 260°,  $\text{C}_{14}\text{H}_{26}$ ; boiling between 320° and 330°,  $\text{C}_{14}\text{H}_{22}$ ; residue left at 350°,  $\text{C}_{14}\text{H}_{18}$ . The remainder of this paper is devoted to a lengthy discussion, accompanied by a large number of formulæ, to explain how the different substances and products of the complex reactions are derived from the original material applied for the preparations.

**Sulpho-Fumaric Acid.**—B. Credner.—Sulpho-fumaric acid,  $\text{COOH.CH}_2\text{CHSO}_2\text{OH.COOH}$ .—The preparation and purification of this substance are described at length; the process is complicated and tedious. The pure material is a syrup-like, very sour fluid, which, by being kept over sulphuric acid, yields traces of crystalline appearance; the acid and its salts, a number of which are described, are isomeric, but not identical with sulpho-succinic acid. Sulpho-fumarate

of potassa,  $\text{C}_4\text{H}_3\text{K}_3\text{SO}_7 + \text{H}_2\text{O}$ , is a crystalline mass which effloresces on exposure to air. Neutral sulpho-fumarate of lead—



is a salt readily soluble in water, in aqueous solution of acetate of lead, and in free acids, and obtained by double decomposition of a potassa salt of the acid in question, can never be obtained quite free from potassa. The basic lead-salt of this acid,  $\text{C}_4\text{H}_3\text{Pb}_3\text{O}_7\text{S} + \text{Pb}_2\text{O}$ , is a crystalline compound, rather insoluble in most menstrua.

**Behaviour of Salicylic Aldehyde when it is Heated with Primary Monamides.**—B. Credner.—This paper treats of the action of acetamide upon salicylic acid at an elevated temperature, resulting in the formation of a substance soluble in alcohol, yielding, on elementary organic analysis, in 100 parts:—C, 57.82, 58.56, 64.35; H, 5.80, 6.18, 5.55; N, 8.01, 7.81. After purification with alcohol, the figures obtained were—C, 65.33, 68.48, 66.29, 63.27; H, 5.81, 6.40, 5.73, 5.69; N, 8.11, 7.35. When salicylic aldehyde was heated with benzamide, a similar substance was obtained.

## NOTES AND QUERIES.

**Estimating the Amount of Lamp-Black in Graphite.**—Will any of your readers kindly inform me, if there is any accurate method by which the amount of lamp-black may be estimated in samples of graphite adulterated with it.—J. REDDROP.

**Coprolite and Bone in Mixed Superphosphates.**—Can anyone give me a process to quantitatively determine the relative amounts of coprolite and bone in a mixed superphosphate?—W. M. B.

**Money-Values of Substances Found in Artificial Manures.**—I have occasional applications made to me to add to my certificates of analysis of manurial substances the "value at prices fixed by chemists." I have not done so, for the twofold reason that (1) I do not consider it within the province of the analyst, and (2) that I do not know what the prices are. Can anyone, therefore, kindly inform me if this custom obtains amongst respectable analysts? and, if so, what are the various money-values of the substances found in the artificial manures now in use?—W. M. B.

## MEETINGS FOR THE WEEK.

- MONDAY, March 7th.—Royal Institution, 2. General Monthly Meeting.  
— Medical, 8.  
— London Institution, 4.  
TUESDAY, 8th.—Royal Institution, 3. Dr. Masters, on "Plant Life."  
— Institution of Civil Engineers, 8.  
— Photographic, 8.  
— Ethnological, 8.  
WEDNESDAY, 9th.—Society of Arts, 8.  
— Geological, 8.  
— Microscopical, 8.  
THURSDAY, 10th.—Royal Institution, 3. Prof. Odling, "Chemistry of Vegetable Products."  
— London Institution, 7.30.  
— Royal, 8.  
— Zoological, 8.30.  
— Royal Society Club, 6.  
FRIDAY, 11th.—Royal Institution, 8. Prof. Westmacott, "On Art."  
— Astronomical, 8.  
— Quekett Microscopical Club, 8.

## TO CORRESPONDENTS.

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R. Noel Hartley.—Your paper, "Concerning Atom-Fixing and Atom-Displacing Powers," will appear in our next.

T. Y.—Consult the Index; you will find communications on the subjects you name.

C. D. H.—H. Baillière, of 219, Regent Street, or any foreign bookseller.

Capt. W. A. Ross, R.A.—In our issue of December 3rd, 1869, we expressed our regret at not having space for your articles. The great demand on our space obliges us to omit articles which appear to be of but little interest to our readers.

A. Freire-Marreco.—When the papers are of great length we should prefer a condensed report, but when important we will always endeavour to insert them unabridged.

## BOOKS RECEIVED.

On the Absorptive Power of Soil, by Robert Warington, F.C.S. Reprinted from "Practice with Science," vol. ii., 1869.

The Food Journal for March.

The Sugar-Cane for March.

On the Influence of Mental Activity on the Excretion of Phosphoric Acid by the Kidneys, by Luther Hodges Wood, Ph.B., M.D.



# THE CHEMICAL NEWS.

VOL. XXI. No. 537.

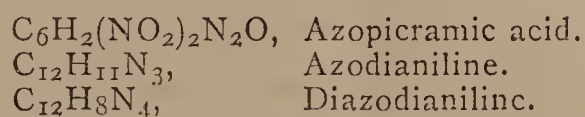
## CONCERNING ATOM-FIXING AND ATOM-DISPLACING POWERS.

By WALTER NOEL HARTLEY, F.C.S.

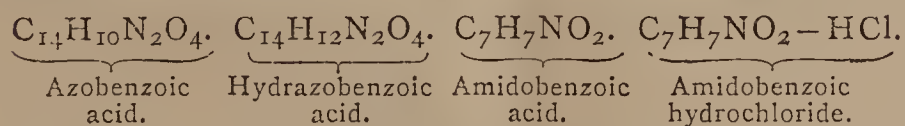
### PART I.

IN Hofmann's "Modern Chemistry" occur these words: "The atomic relations which we call quantivalence imply not only atom-fixing, but atom-displacing power; so that, in learning how many standard units of quantivalence any given elementary atom may attract and retain within a compound molecule, we learn, also, how many it can remove therefrom." According to notions now received, and facts recorded, this, with a certain class of compounds, would appear not to be the case. In Hofmann's work, nitrogen and its congeners are treated as merely trivalent; but they are now well-known to have pentad functions.

Many compounds have been obtained by Griess,\* in which N substitutes H<sub>3</sub>, for instance—

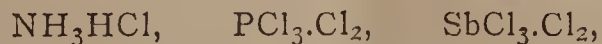


I can find, however, no instance of its displacing five standard atoms; on the other hand, in ammonium-chloride it fixes five. Here, then, is an example, showing that atom-fixing is not identical with atom-displacing power. Again, P, which is trivalent to H, is both a triad and a pentad to Cl—e.g., PCl<sub>3</sub>.PCl<sub>5</sub>. From consideration of these and similar facts, I believe that, in certain elements, the full atom-fixing or displacing power is not exercised, but is partially suppressed or lies latent. For instance, Strecker obtained azobenzoic acid, in which N displaces only one atom of hydrogen, C<sub>14</sub>H<sub>10</sub>N<sub>2</sub>O<sub>4</sub>; by treating this with ferrous hydrate, the N takes up H; by boiling with hydrochloric acid, one other atom, H; and subsequently it fixes HCl, thus:—



In the first instance, four atom-fixing powers lie latent, and they are gradually revealed until a saturated compound results.

Elements of the nitrogen class† have a much greater power of fixing three atoms than five, their most stable compounds being triadic; in fact, these compounds act as bivalent radicles, and fix two other atoms, thus:—

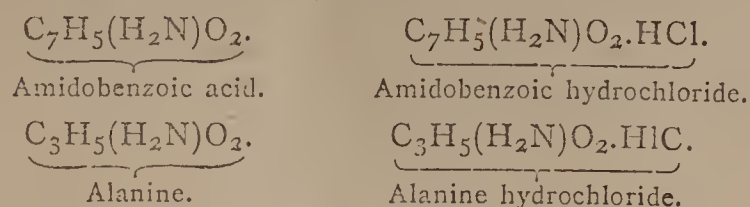


just as certain oxygen compounds do—e.g.,



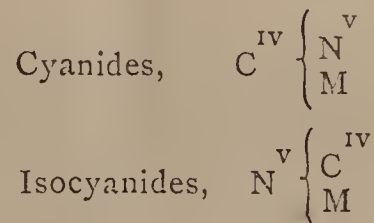
This is an instance of what is invariably the case—viz., that the saturating power, or quantivalence, of a compound radicle is dependent on the quantivalence of the elements entering into its composition. Seeing that, in Griess's compounds, N displaces three, instead of five atoms, and, on the other hand, in NH<sub>4</sub>HCl it fixes five, we may infer that the two weaker atom-fixing powers are incapable of displacing atoms, although they have the power of fixing them on to a molecule. The amides bear this out:

NH<sub>2</sub> can fix three atoms; it displaces only one, however, and then fixes other two, thus—



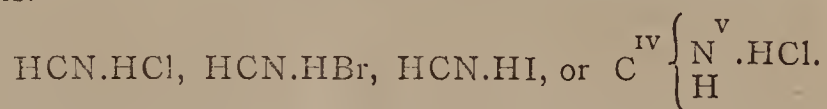
Amidogen never displaces three atoms of hydrogen from a compound, because atom-fixing is not identical with atom-displacing power.

The compound HCN has the H combined with the C. Nitrogen being a pentad, the carbon is insufficient to saturate it; we have, therefore, two free atom-fixing powers of the nitrogen in this body. Naquet mentions this in his "Cours de Chimie." The cyanides then have the following constitution:—

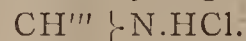


M = a metallic body.

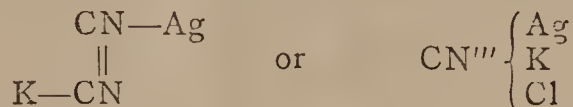
Cyanogen is, then, a trivalent radicle; the crystalline compounds of Gauthier and Gal, of prussic acid with the haloid acids, abolish the need of any further proof of this.



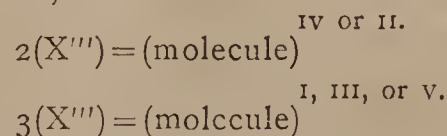
Hydrocyanic acid is a tertiary monamine, in which the radicle CH<sup>III</sup> replaces three hydrogen atoms—



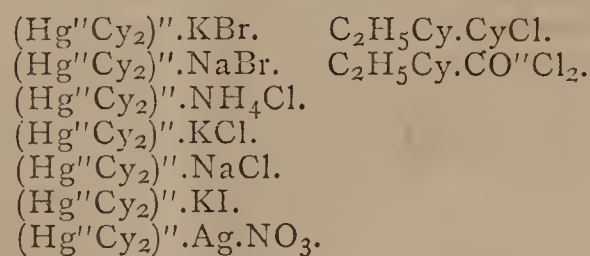
The double cyanides of silver and potassium, also chlorocyanide of silver and potassium, may be thus represented:—



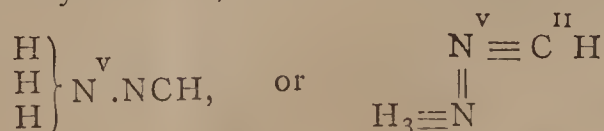
A trivalent radicle, when doubled to form one molecule, may become either tetrad or dyad; when trebled, either monad, triad, or pentad, in its functions, according to its inner constitution, thus:—



From this it is easy to see how the immense variety of complicated cyanides arise; to take the mercury compounds first, we have—



Of all unstable substances, cyanide of ammonium is most strangely so; it gives off ammonia and hydrocyanic acid at ordinary temperatures, and simultaneously. The reason of this is apparent when we consider that the weaker atom-fixing powers of the nitrogen in the ammonium are united to the weaker ones of the same element in the hydrocyanic acid, thus:—

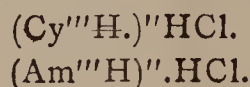


Amidogen, H<sub>2</sub>N, is an analogue of cyanogen—that is to say, it replaces an atom of hydrogen or chlorine in various compounds.

\* Ann. Chem. und Pharm., vol. cxiii., p. 201.  
† Odling, in Watts's "Dictionary."



It is evident that it resembles it closely, in being trivalent as well as univalent, in the same manner as cyanogen, by virtue of the two weaker atom-fixing powers of its nitrogen. The ammonium haloid salts resemble the compounds of Gauthier and Gal, thus:—



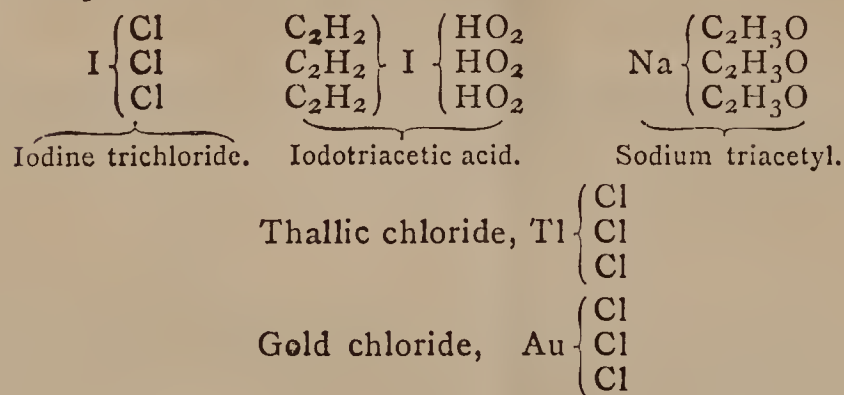
It is only necessary to recall the fact that amidogen displaces H from a molecule, and then fixes HCl in order to prove its trivalency.

Chlorine and its congeners form an exceedingly well-defined group of radicles; any compound into which one of these enters is sure to have its analogue, in which the others take part. In addition, however, to the halogens, the mono-metallic bodies come under the same quantivalence class; they form analogous compounds, have the same atomic heat,\* and the same capability of displacing each other.

These elements, resembling each other to such an extent in their general powers of forming and entering into compounds, are—

H.	Tl.
K.	Au.
Na.	F. (?)
Ag.	Cl.
Cæ. (?)	Br.
R. (?)	I.

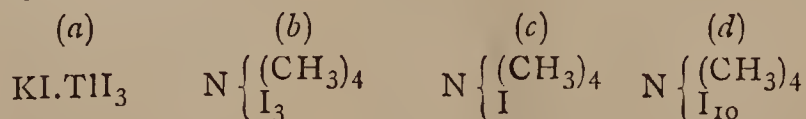
Of this list, thallium and gold are always admitted to be triads; iodine was shown by Schutzenberger† to be a triad; and Wanklyn has shown the possibility of sodium possessing triad functions. The compounds relating to this question are the following:—



Of the above twelve elements, three are comparatively little known—Cæ, R, and F; of the remaining nine, four are shown to be triads, but their monad characters are the much more marked, just as in the nitrogen group. The trivalent are more predominant than the pentad functions; the reason of this I consider to be the same in each case; two of the atom-fixing powers in each class of radicles are weaker than the others. As nitrogen and its congeners have a greater power of combining with three than five atoms, so these elements have a greater power of combining with one than three. It is not at all satisfactory, when contemplating such compounds as sodium triacetyl, iodo-triacetic acid, and iodic chloride, to be unable to account for these under the orthodox views; it rids us of the difficulty; but it is still less satisfactory to ignore their existence altogether.

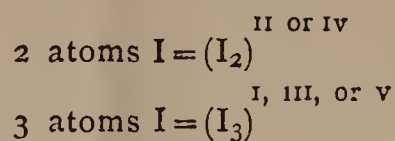
A monad atom can form only one combination with any other monad; this is represented by XA; it is a union of atom with atom. It is impossible for this combination to unite with anything else, both elements being saturated.

Let us consider now what combinations of iodine—for instance, with univalent radicles, and apparently saturated compounds, exist.

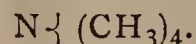


How is it possible to account for these?

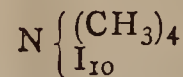
Recognise I as trivalent, and the problem is without difficulty.



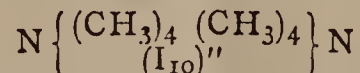
In (a), the iodine of the potassium unites with that of the thallium, and together they form a di or tetra molecule, to saturate K and Tl. With (b) and (c), the molecules\*  $(\text{I}_3''')$  and  $(\text{I}_5''')$  are both univalent, and therefore fill up the unsaturated combinations—



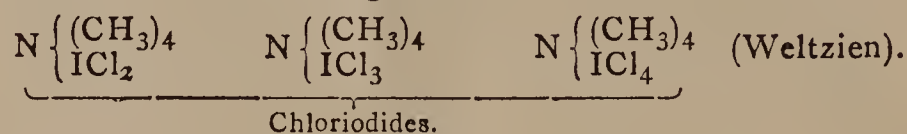
The substance (d) is more unstable than the others, which is natural from its being, perhaps, an unsaturated molecule—



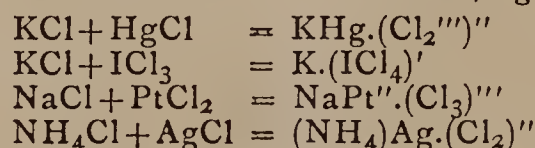
It is possible, however, it results from such a combination as this—



In either case, it does not affect the question. As for chlorine, if purely univalent in its functions, what is to become of the following bodies?



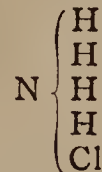
It is evident their constitution is similar to that of the iodides. A few instances of double chlorides will further strengthen the evidence of triad character, e.g.—



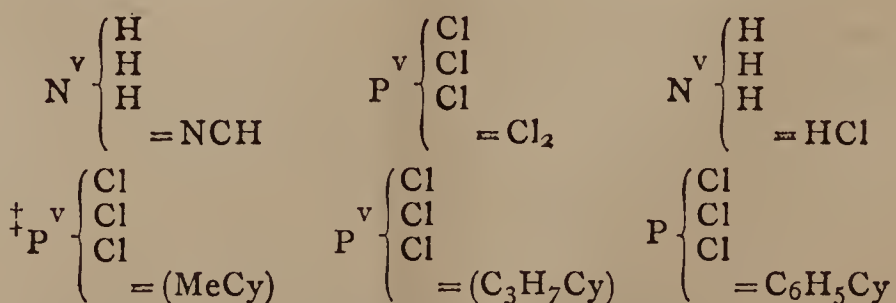
Bromine is no exception; but fluorine I am inclined to believe to be a dyad, as suggested by Mr. Gore.†

If H and Cl be monad elements, in combination they will completely saturate each other, how comes it, then, that a completely saturated compound should unite with  $\text{H}_3\text{N}$ , a ready-formed molecule? These weaker atom-fixing powers of the nitrogen must have the power of splitting up the HCl, in order, first, to fix the atom H, and then the Cl to it; again, at a temperature of  $300^\circ \text{C}$ ., or thereabouts, ammonium-chloride parts with HCl, again unchanged.

Now, if the constitution of sal ammoniac be—



It is only reasonable to expect that heat would drive off, first, either the chlorine or the hydrogen, in which case Pebal, in his experiments proving dissociation, would have found free chlorine: but no; we find the H and Cl coming off in combination. Consider chlorine from the new point of view, and chloride of ammonium like the cyanide, and then how plain is everything— $(\text{NH}_3)'' \cdot (\text{HCl})''$ .  $\text{NH}_3$  and HCl are both divalent molecules: they combine and separate without disturbance. The following are parallel cases:—



\* The word molecule I use to signify a group of atoms merely.

† *Proceedings of the Royal Society*, 1869.

‡ Henke (*Ann. der Chem. und Pharm.*, vol. cvi., p. 272).

\* Canizzaro.

† Wurtz ("Philosophie Chimique").



We have no such easy separation of ammonia from its combinations with oxyacids; from phosphoric acid, a red heat is necessary to remove it; the nitrate decomposes in nitrous oxide and water, &c. On the other hand, another halogen salt, the iodide, decomposes at ordinary temperatures. A further illustration of the same decomposition, giving rise to an anomalous vapour density, is furnished by the bromhydride of amylene,  $(C_{10}H_{10}) \cdot HBr$ .

As further evidence that various chlorides are not saturated compounds, and thus resemble hydrochloric acid, although the metallic or other radicles are combined with chlorine to their greatest extent, I will quote a few examples of nitriles united with chlorides:—

Ti $Cl_4 \cdot HCN$ .*	Ti $Cl_4 \cdot MeCy$ .†	Ti $Cl_4 \cdot EtCy$ .
Sn $Cl_4 \cdot 2HCN$ .†	Sn $Cl_4 \cdot MeCy$ .	Sn $Cl_4 \cdot EtCy$ .
Sb $Cl_5 \cdot 3HCN$ .†	Sb $Cl_5 \cdot MeCy$ .	Sb $Cl_5 \cdot EtCy$ .
$Fe_2Cl_3 \cdot 2HCN$ .†	$Fe_2Cl_3 \cdot MeCy$ .	$Fe_2Cl_3 \cdot EtCy$ .
	&c., &c.	&c., &c.

Sb  $Cl_5 \cdot CyCl$ .†  
Bo  $Cl_3 \cdot CyCl$ . (Martius.) EtCy.CyCl.  
 $Fe_2Cl_3 \cdot CyCl$ .†  
Ti  $Cl_4 \cdot CyCl$ .

London, Feb. 24, 1870.

# ON THE CONTINUITY OF THE GASEOUS AND LIQUID STATES OF MATTER.\*

By THOMAS ANDREWS, M.D., F.R.S.,  
Vice-President of Queen's College, Belfast.

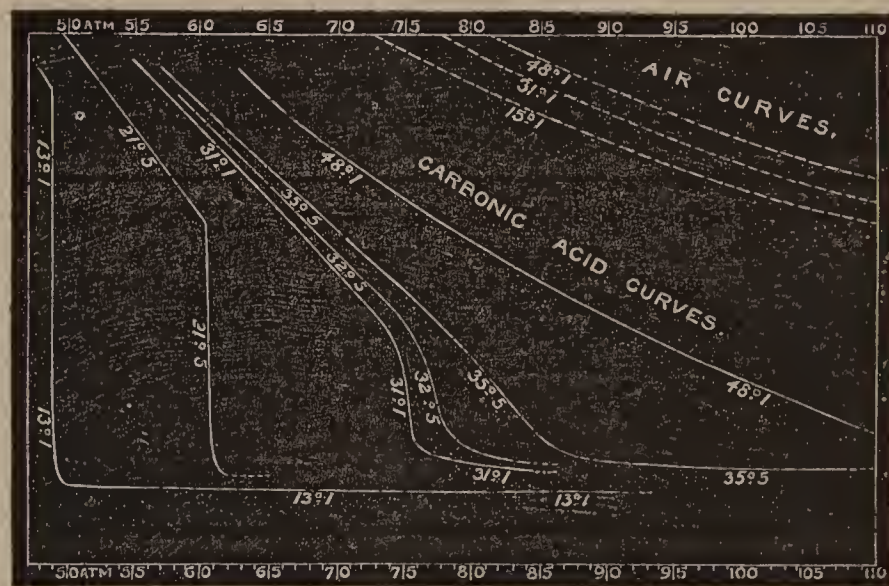
(Concluded from p. 103).

At the pressure of 48.89 atmospheres, as measured by the contraction of the air in the air-tube, liquefaction began. This point could not be fixed by direct observation, inasmuch as the smallest visible quantity of liquid represented a column of gas at least 2 or 3 m.m. in length. It was, however, determined indirectly by observing the volume of the gas  $0.2^\circ$  or  $0.3^\circ$  above the point of liquefaction, and calculating the contraction the gas would sustain in cooling down to the temperature at which liquefaction began. A slight increase of pressure was required even in the early stages to carry on the process. Thus the air-gauge, after all reductions were made, indicated an increase of pressure of about one-fourth of an atmosphere (from 48.49 to 49.15 atmospheres) during the condensation of the first and second thirds of the carbonic acid. According to theory, no change of volume ought to have occurred. This apparent anomaly is explained by the presence of the trace of air (about 1-500th part) in the carbonic acid to which I before referred. It is easy to see that the increase of pressure shown in these experiments is explained by the presence of this small quantity of air. If a given volume of carbonic acid contain 1-500th of air, that air will be diffused through a space 500 times greater than if the same quantity of air were in a separate state. Compress the mixture till 50 atmospheres of pressure have been applied, and the air will now occupy, or be diffused through, ten times the space it would occupy if alone and under the pressure of one atmosphere; or it will be diffused through the space it would occupy, if alone and under the pressure of 1-10th of an atmosphere. While the carbonic acid is liquefying, pressure must be applied in order to condense this air; and to reduce it to one-half its volume, an increase of 1-10th of an atmosphere is required. The actual results obtained by experiment approximate to this calculation. From similar considerations, it follows that if a

mixture of air and carbonic acid be taken, for example in equal volumes, the pressure, after liquefaction has begun, must be augmented by several atmospheres, in order to liquefy the whole of the carbonic acid. Direct experiments have shown this conclusion to be true.

The small quantity of air in the carbonic acid disturbed the liquefaction in a marked manner, when nearly the whole of the carbonic acid was liquefied, and when its volume relatively to that of the uncondensed carbonic acid was considerable. It resisted for some time absorption by the liquid, but on raising the pressure to 50.4 atmospheres it was entirely absorbed. If the carbonic acid had been absolutely pure, the part of the curve for  $13.1^\circ$  representing the fall from the gaseous to the liquid state, would doubtless have been straight throughout its entire course, and parallel to the lines of equal pressure.

FIG. 4.



The curve representing the results at  $21.5^\circ$  agrees in general form with that for  $13.1^\circ$ , as shown in the above figure. At  $13.1^\circ$ , under a pressure of about 49 atmospheres, the volume of carbonic acid is little more than three-fifths of that which a perfect gas would occupy under the same conditions. After liquefaction, carbonic acid yields to pressure much more than ordinary liquids; and the compressibility appears to diminish as the pressure increases. The high rate of expansion by heat of liquid carbonic acid, first noticed by Thilorier, is fully confirmed by this investigation.

The next series of experiments was made at the temperature of  $31.1^\circ$ , or  $0.2^\circ$  above the point at which, by compression alone, carbonic acid is capable of assuming visibly the liquid form. Since I first announced this fact in 1863, I have made careful experiments to fix precisely the temperature of this critical point in the case of carbonic acid. It was found in three trials to be  $30.92^\circ C$ , or  $87.7^\circ F$ . Although for a few degrees above this temperature a rapid fall takes place from increase of pressure, when the gas is reduced to the volume at which it might be expected to liquefy, no separation of the carbonic acid into two distinct conditions of matter occurs, so far as any indication of such a separation is afforded by the action of light. By varying the pressure or temperature, but always keeping above  $30.92^\circ$ , the great changes of density which occur about this point produce the flickering movements I formerly described, resembling in an exaggerated form the appearances exhibited during the mixture of liquids of different densities, or when columns of heated air ascend through colder strata. It is easy so to adjust the pressure that one-half of the tube shall be filled with uncondensed gas and one-half with the condensed liquid. Below the critical temperature this distinction is easily seen to have taken place, from the visible surface of demarcation between the liquid and gas, and from the shifting at the same surface of the image of any perpendicular line placed behind the tube. But above  $30.92^\circ$  no such appearances are seen, and the most careful examina-

\* Wöhler (*Ann. der Chem. und Pharm.*, vol. lxxiii., p. 226).

† Klein (*Ann. der Chem. und Pharm.*, vol. lxxiv., p. 86).

‡ Henke (*Ann. der Chem. und Pharm.*, vol. cvi., p. 280).

\* The Bakerian Lecture for 1869, delivered before the Royal Society. Communicated to the CHEMICAL NEWS, and revised by the author.



tion fails to discover any heterogeneity in the carbonic acid, as it exists in the tube.

The graphical representation of these experiments, as shown in Fig. 4, exhibits some marked differences from the curves for lower temperatures. The dotted lines in the figure represent a portion of the curves of a perfect gas (assumed to have the same volume at  $0^{\circ}$  and under one atmosphere as the carbonic acid) for the temperatures of  $13.1^{\circ}$ ,  $31.1^{\circ}$ , and  $48.1^{\circ}$ . The volume of the carbonic acid at  $31.1^{\circ}$ , it will be observed, diminishes with tolerable regularity, but much faster than according to the law of Mariotte, till a pressure of about 73 atmospheres is attained. The diminution of volume then goes on very rapidly, a reduction to nearly one-half taking place, when the pressure is increased from 73 to 75 atmospheres, or only by 1-37th of the whole pressure. The fall is not, however, abrupt as in the case of the formation of the liquid at lower temperatures, but a steady increase of pressure is required to carry it through. During this fall, as has already been stated, there is no indication at any stage of the process of two conditions of matter being present in the tube. Beyond 77 atmospheres carbonic acid at  $31.1^{\circ}$  yielded much less than before to pressure, its volume having become reduced nearly to that which it ought to occupy as a liquid at the temperature at which the observations were made.

The curve for  $32.5^{\circ}$  (Fig. 4) resembles closely that for  $31.1^{\circ}$ . The fall is, however, less abrupt than at the latter temperature. The range of pressure in the experiments at  $35.5^{\circ}$  extends from 57 to above 107 atmospheres. The fall is here greatly diminished, and it has nearly lost its abrupt character. It is most considerable from 76 to 87 atmospheres, where an increase of one-seventh in the pressure produces a reduction of volume to one-half. At 107 atmospheres the volume of the carbonic acid has come almost into conformity with that which it should occupy, if it were derived directly from liquid carbonic acid, according to the law of the expansion of that body for heat.

The curve for  $48.1$  is very interesting. The fall shown in the curves for lower temperatures has almost, if not altogether, disappeared, and the curve itself approximates to that which would represent the change of volume in a perfect gas. At the same time the contraction is much greater than it would have been if the law of Mariotte had held good at this temperature. Under a pressure of 109 atmospheres, the carbonic acid is rapidly approaching to the volume it would occupy if derived from the expansion of the liquid; and if the experiment had not been interrupted by the bursting of one of the tubes, it would doubtless have fallen into position at a pressure of 120 or 130 atmospheres.

I have not made any measurements at higher temperatures than  $48.1^{\circ}$ ; but it is clear that, as the temperature rises, the curve would continue to approach to that representing the change of volume of a perfect gas.

I have frequently exposed carbonic acid, without making precise measurements, to much higher pressures and have made it pass, without break or interruption, from what is regarded by every one as the gaseous state, to what is, in like manner, universally regarded as the liquid state. Take, for example, a given volume of carbonic acid gas at  $50^{\circ}$  C., or at a higher temperature, and expose it to increasing pressure till 150 atmospheres have been reached. In this process its volume will steadily diminish as the pressure augments, and no sudden diminution of volume, without the application of external pressure, will occur at any stage of it. When the full pressure has been applied, let the temperature be allowed to fall till the carbonic acid has reached the ordinary temperature of the atmosphere. During the whole of this operation no breach of continuity has occurred. It begins with a gas, and by a series of gradual changes, presenting nowhere any abrupt alteration of volume or sudden evolution of heat, it ends with a liquid. The closest observation fails to discover anywhere indications of a change of

condition in the carbonic acid, or evidence, at any period of the process, of part of it being in one physical state and part in another. That the gas has actually changed into a liquid would, indeed, never have been suspected, had it not shown itself to be so changed by entering into ebullition on the removal of the pressure. For convenience, this process has been divided into two stages, the compression of the carbonic acid and its subsequent cooling; but these operations might have been performed simultaneously, if care were taken so to arrange the application of the pressure and the rate of cooling, that the pressure should not be less than 76 atmospheres when the carbonic acid had cooled to  $31^{\circ}$ .

We are now prepared for the consideration of the following important question. What is the condition of carbonic acid when it passes, at temperatures above  $31^{\circ}$ , from the gaseous state down to the volume of the liquid, without giving evidence at any part of the process of liquefaction having occurred? Does it continue in the gaseous state, or does it liquefy, or have we to deal with a new condition of matter? If the experiment were made at  $100^{\circ}$ , or at a higher temperature, when all indications of a fall had disappeared, the probable answer which would be given to this question is that the gas preserves its gaseous condition during the compression; and few would hesitate to declare this statement to be true, if the pressure, as in Natterer's experiments, were applied to such gases as hydrogen or nitrogen. On the other hand, when the experiment is made with carbonic acid at temperatures a little above  $31^{\circ}$ , the great fall which occurs at one period of the process would lead to the conjecture that liquefaction had actually taken place, although optical tests carefully applied failed at any time to discover the presence of a liquid in contact with a gas. But against this view it may be urged with great force, that the fact of additional pressure being always required for a further diminution of volume, is opposed to the known laws which hold in the change of bodies from the gaseous to the liquid state. Besides, the higher the temperature to which the gas is compressed, the less the fall becomes, and at last it disappears.

The answer to the foregoing question, according to what appears to me to be the true interpretation of the experiments already described, is to be found in the close and intimate relations which subsist between the gaseous and liquid states of matter. The ordinary gaseous and ordinary liquid states are, in short, only widely separated forms of the same condition of matter, and may be made to pass into one another by a series of gradations so gentle that the passage shall nowhere present any interruption or breach of continuity. From carbonic acid as a perfect gas to carbonic acid as a perfect liquid, the transition we have seen may be accomplished by a continuous process, and the gas and liquid are only distant stages of a long series of continuous physical changes. Under certain conditions of temperature and pressure, carbonic acid finds itself, it is true, in what may be described as a state of instability, and suddenly passes, with the evolution of heat, and without the application of additional pressure or change of temperature, to the volume, which by the continuous process can only be reached through a long and circuitous route. In the abrupt change which here occurs, a marked difference is exhibited, while the process is going on, in the optical and other physical properties of the carbonic acid which has collapsed into the smaller volume, and of the carbonic acid not yet altered. There is no difficulty here, therefore, in distinguishing between the liquid and the gas. But in other cases the distinction cannot be made; and under many of the conditions I have described it would be vain to attempt to assign carbonic acid to the liquid rather than the gaseous state. Carbonic acid, at the temperature of  $35.5^{\circ}$ , and under a pressure of 108 atmospheres, is reduced to 1-430th of the volume it occupied under a pressure of one atmosphere; but if any one ask whether it is now in the gaseous or liquid state, the question does not, I believe,



admit of a positive reply. Carbonic acid at  $35^{\circ}5'$ , and under 108 atmospheres of pressure, stands nearly midway between the gas and the liquid; and we have no valid grounds for assigning it to the one form of matter any more than to the other. The same observation would apply with even greater force to the state in which carbonic acid exists at higher temperatures and under greater pressures than those just mentioned. In the original experiment of Cagniard de la Tour, that distinguished physicist inferred that the liquid had disappeared, and had changed into a gas. A slight modification of the conditions of his experiment would have led him to the opposite conclusion, that what had been before a gas was changed into a liquid. These conditions are, in short, the intermediate states which matter assumes in passing, without sudden change of volume, or abrupt evolution of heat, from the ordinary liquid to the ordinary gaseous state.

In the foregoing observations I have avoided all reference to the molecular forces brought into play in these experiments. The resistance of liquids and gases to external pressure tending to produce a diminution of volume, proves the existence of an internal force of an expansive or resisting character. On the other hand, the sudden diminution of volume, without the application of additional pressure externally, which occurs when a gas is compressed, at any temperature below the critical point, to the volume at which liquefaction begins, can scarcely be explained without assuming that a molecular force of great attractive power comes here into operation, and overcomes the resistance to diminution of volume, which commonly requires the application of external force. When the passage from the gaseous to the liquid state is effected by the continuous process described in the foregoing pages, these molecular forces are so modified as to be unable at any stage of the process to overcome alone the resistance of the fluid to change of volume.

The properties described in this communication, as exhibited by carbonic acid, are not peculiar to it, but are generally true of all bodies which can be obtained as gases and liquids. Nitrous oxide, hydrochloric acid, ammonia, sulphuric ether, and sulphuret of carbon, all exhibited, at fixed pressures and temperatures, critical points, and rapid changes of volume with flickering movements, when the temperature or pressure was changed in the neighbourhood of those points. The critical points of some of these bodies were above  $100^{\circ}$ ; and in order to make the observations, it was necessary to bend the capillary tube before the commencement of the experiment, and to heat it in a bath of paraffin or oil of vitrol.

The distinction between a gas and vapour has hitherto been founded on principles which are altogether arbitrary. Ether in the state of gas is called a vapour, while sulphurous acid in the same state is called a gas; yet they are both vapours, the one derived from a liquid boiling at  $35^{\circ}$ , the other from a liquid boiling at  $-10^{\circ}$ . The distinction is thus determined by the trivial condition of the boiling point of the liquid, under the ordinary pressure of the atmosphere, being higher or lower than the ordinary temperature of the atmosphere. Such a distinction may have some advantages for practical reference, but it has no scientific value. The critical point of temperature affords a criterion for distinguishing a vapour from a gas, if it be considered important to maintain the distinction at all. Many of the properties of vapours depend on the gas and liquid being present in contact with one another; and this, we have seen, can only occur at temperatures below the critical point. We may accordingly define a vapour to be a gas at any temperature under its critical point. According to this definition, a vapour may, by pressure alone, be changed into a liquid, and may therefore exist in presence of its own liquid; while a gas cannot be liquefied by pressure, that is, so changed by pressure as to become a visible liquid distinguished by a surface of demarcation from the gas. If this definition be accepted, carbonic acid will be a vapour below  $31^{\circ}$ , a gas above

that temperature; ether, a vapour below  $200^{\circ}$ , a gas above that temperature.

We have seen that the gaseous and liquid states are only distant stages of the same condition of matter, and are capable of passing into one another by a process of continuous change. A problem of far greater difficulty yet remains to be solved, the possible continuity of the liquid and solid states of matter. The fine discovery made some years ago by James Thomson, of the influence of pressure on the temperature at which liquefaction occurs, and verified experimentally by Sir W. Thomson, points, as it appears to me, to the direction this inquiry must take: and in the case at least of those bodies which expand in liquefying, and whose melting points are raised by pressure, the transition may possibly be effected. But this must be a subject for future investigation; and for the present I will not venture to go beyond the conclusion I have already drawn from direct experiment, that the gaseous and liquid forms of matter may be transformed into one another by a series of continuous and unbroken changes.

#### ON THE ACTION OF SODIUM ON ACETIC ETHER.

By J. ALFRED WANKLYN.

IN reply to Frankland and Duppa's note on this subject, read before the Royal Society on Thursday last, I wish to point out that, in addition to the obvious source of fallacy arising from the presence of alcohol in the acetic ether taken for experiment, there is another fallacy depending upon the production of alcohol by secondary action during the course of the experiment. This secondary action consists in the now well-known reaction between acetic ether and ethylate of sodium, whereby acetate of ethylene-sodium and alcohol are formed. If the details of Frankland and Duppa's paper be examined, it will be found that they have given no adequate proof of the original purity of the acetic ether employed by them, and that they have operated under conditions eminently favourable for the production of alcohol by action of acetic ether on the ethylate of sodium, which is an admitted product of the action of sodium on the ether. The high temperature ( $130^{\circ}$  C. they tell us) and the great length of time taken for the experiment, viz., several days, afford these favourable conditions.

I have no doubt that every trace of hydrogen obtained by Frankland and Duppa proceeded from alcohol.

The explanation which these chemists have offered in order to account for my not getting hydrogen, will, I think, not find general acceptance. In the instance of acetate of amyl, which did not give a trace of gas, I operated under little more than ordinary atmospheric pressure, for this ether boils at  $140^{\circ}$  C., and I heated only to  $100^{\circ}$  C. And, finally, I found that potassium dissolves without effervescence in pure acetic ether contained in an open vessel at ordinary atmospheric pressure. In 1840, Löwig published a similar assertion on the action of potassium on acetic ether.

#### ON MICROSCOPICAL MANIPULATION.

By W. T. SUFFOLK, F.R.M.S.

(Continued from p. 101).

##### LESSON II.

*Material for Examination—Dirt from Sponges.*

THIS can be obtained in any quantity from dealers. It accumulates at the bottom of the boxes in which sponge is imported.

Arrange the microscope as in the former lesson, O2, Illuminator. PARABOLIC LIEBERKUHN or [Con-



*condensing-Lens*].—If artificial light is used, render the rays parallel (vol. xx., p. 255) before they are reflected from the lieberkuhn.

Spread a small portion of the substance over the stage-plate.

The specimen will most likely be found to consist chiefly of sand, which prevents a good view of the other substances in it being obtained, although, here and there, some objects may be seen. The sand may be removed by sifting through a piece of wire-gauze, of about 40—50 threads to the inch; or a series of sieves may be used, if it is wished to carry out the sorting to a greater extent. Examine some of the coarse residue as before. The principal contents will be coarse sand and fragments of rock, fibre, abraded splinters of wood, seaweed, fragments of *Echinus* spines, skeletons of various *Hydrozoa* and *Polysphaera* (vulg., *Zoophytes*), sponge, spicules, and shells.

Separate the shells and other objects that may be required for further study; this may be done by picking them up with a small camel-hair pencil, moistened and drawn to a point. Small pill-boxes or homœopathic-bottles make convenient receptacles for keeping these objects in, when sorted. A pocket-lens mounted on a stand, or a watchmaker's glass will afford sufficient magnifying power. If the light is concentrated upon the substance to be examined with the condensing-lens, and black paper used to spread the sand on, a great deal may be done without using the glass at all. For dissecting and more delicate operations of this kind, Beck's 3-inch binocular magnifier will be found useful: it is, in effect, a pair of achromatic spectacles of considerable power, and fatigues the eyes less in prolonged operations than the use of a single lens. A more complete binocular dissecting is described in "Carpenter," p. 54.

Select some of the shells resembling small nautili (*Foraminifera*), and make arrangements for examining them in varied positions with DISC-HOLDER (vol. xx., p. 193) or [*stage-forceps*]. Observe the peculiar structure of the part where the mouth of an ordinary univalve-shell (*Gasteropoda*) usually is, closed with a perforated plate, instead of being open. Also, in some species, perforations will be observed on the sides of the shells: hence the name of the group *Foraminifera*. Mount some of the shells dry in various positions (taking especial care that the mouth is well displayed), label, and preserve for reference.

Bed some of the shells in balsam (vol. xx., p. 208), and grind away the surface so as to expose the interior; carefully polish, and remove the balsam. This process will reveal the chambered internal structure, which varies extremely in different species. An increase of power may now be used with advantage ( $O_1$ , or  $O_{\frac{1}{2}}$  if the illuminator for this higher objective is accessible). With such augmented power, the minute shell-structure may be observed; but this can be accomplished more readily by grinding a thin section, which will admit of examination with higher powers and the paraboloid or achromatic condenser. These thin sections can be ground by a process devised by Dr. Wallich (*Ann. Nat. Hist.*, July, 1861; also "Carpenter," p. 192, note). The shell is to be fastened to a thin plate of mica, in the first instance, and this, with the shell upwards, is to be cemented to the plate of glass on which it is held during the process. One side is ground and polished in the usual manner. The

slide is then warmed, which permits the removal of the mica plate with the half-finished section attached. The shell is then cemented by its polished side to another grinding-plate, and completed in the usual manner. The plate of mica is easily ground away, and offers no impediment to the cutting of the shell. The resulting section is to be mounted, either dry or in balsam, as circumstances may require.

*Foraminifera* and other shells abound in deep-sea soundings. As usually obtained from this source, they are mixed with the tallow placed at the bottom of the lead to bring up the sample: this grease must be removed by solution in benzol. *Foraminifera* and other fossils may be separated from chalk by processes described in Lesson 3.

For further information respecting the *Foraminifera*, see art. *Foraminifera*, "Micrographic Dictionary," p. 292; "Carpenter," pp. 482—523; Greene's "Manual of the Protozoa"; Williamson and Carpenter's Monographs (Ray Society).

(To be continued.)

## PROCEEDINGS OF SOCIETIES.

### CHEMICAL SOCIETY.

March 3rd, 1870.

Dr. A. W. WILLIAMSON, F.R.S., &c., President, in the Chair.

MR. C. P. SANDBERG, of Stockholm, was elected a Fellow of the Society.

The first paper was by Dr. GLADSTONE, on "*Refraction Equivalents*."

Three distinct lines of research had led up to the discovery of these equivalents. The first was the influence of temperature on the refraction of light by liquids; the second, the refraction of mixtures or combinations as compared with that of their constituents; and the third, the refractive indices of different members of homologous series of organic compounds. As to the first of these, it was found, by the joint labours of Dr. Gladstone and the Rev. Pelham Dale, that the refraction and the dispersion decrease as the temperature rises. Further examination showed a close relation between the change of density and the change of the refractive index minus unity, which the experimenters termed the "refractive energy," and which is expressed in the language as  $n - 1$ . This energy, divided by the density, that is,

$$\frac{n - 1}{d}$$

is called the "specific refractive energy," and is, in the case of liquids, a constant, not affected by temperature. This conclusion was subsequently confirmed by the experiments of Landolt, Wüllner, and Köhlmann. As to the second line of research (that of the refraction of mixtures, solutions, and simple combinations), Dulong attempted to show in regard to gases, and Hock in regard to some liquids, that the refractive power of a mixture is the mean of the refractive powers of its constituents. But Gladstone and Dale arrived at the conclusion that here, also, the nearest approximation to the truth was given by

$$\frac{n - 1}{d};$$

and their opinion has been fully confirmed by the careful experiments of Wüllner. This general expression holds good, also, in the case of a gas or a solid in solution; and, indeed, it was expected to be so, for water, phosphorus, and sulphur have the same energies in the liquid



and solid states. The question now presented itself—Does an elementary substance retain its specific power of retarding rays when it is combined chemically with other elements? An affirmative reply was suggested by many considerations. It was, for instance, found that bromoform ( $\text{CHBr}_3$ ) and bibromide of bromethylene ( $\text{C}_2\text{H}_3\text{Br}_3$ ) have almost the same specific refractive energy as bromine itself.

On the other hand, however, the investigators observed that isomeric liquids were not always identical in refractive energy; and that the replacement of hydrogen by oxygen in organic compounds effected a much greater optical change in some instances than in others. Hence the conclusion was drawn that the specific refractive energy of every liquid is composed of the specific refractive energies of its component elements, modified by the manner of combination.

The third line of research was that of the refractions of different homologous compounds. The experiments of Delffs, of Landolt, and of Gladstone and Dale, have led to the view that, in all the series containing the radicles, methyl and its congeners, the specific refractive energies increase as the series advances, and that the amount of optical change is less between the higher than between the lower members of the series. Landolt, adopting Gladstone and Dale's formula for the specific refractive energy, multiplied it by the atomic weight  $P$ ; and this

$$P \frac{u-1}{d}$$

he designated the "refraction-equivalent." According to this representation, the refraction-equivalent of a body is the sum of the refraction-equivalents of its constituent elements. The great advantage of this kind of expression is that it permits of the easy comparison of the optical properties of different substances. By making these comparisons, Landolt found that the refraction-equivalent of carbon is 5.0; that of hydrogen, 1.3; and that of oxygen, 3.0. Direct experiments have given figures very close to these. The way of calculating the refraction-equivalent of a compound from these data may be illustrated by ether,  $\text{C}_4\text{H}_{10}\text{O} = 4(5.0) + 10(1.3) + 3.0 = 36.0$ . The refraction-equivalent deduced from observation is 36.26. A great variety of liquids have given, by calculation, the same figures for the refraction-equivalents as by direct investigation. Yet there are exceptions to this agreement with theory. The whole group of the aromatic hydrocarbons and their derivatives give refraction-equivalents much above the calculated numbers. This anomaly must be due to an erroneous representation of the constitution of their nucleus, which cannot be greater than  $\text{C}_6\text{H}_3$ . However, the above method makes it possible to find the refraction-equivalents of bodies which could not otherwise be taken—for instance, of metals. The refraction-equivalents of fifty elements have been determined in this way.

It is to be remarked that the figures in the following list, which gives the refraction-values of the more important elements, represent  $A$  of the solar spectrum:—

Aluminium	8.4	Manganese	12.2—26.2
Barium ..	15.8	Mercury ..	21.3—29.0
Bromine ..	15.3—16.9	Nitrogen ..	4.1—5.3
Calcium ..	10.4	Oxygen ..	2.9
Carbon ..	5.0	Phosphorus	18.3
Chlorine ..	9.9—10.7	Platinum ..	26.0
Chromium	15.9—23.0	Potassium	8.1
Copper ..	11.6	Silicon ..	7.5—6.8
Hydrogen	1.3—3.5	Silver ..	13.5
Iodine ..	24.5—27.2	Sodium ..	4.8
Iron ..	12.0—20.1	Sulphur ..	16.0
Lead ..	24.8	Tin ..	27.0—19.2
Magnesium	7.0	Zinc ..	10.2

It will be seen that some of the elements have a double value; and this peculiarity is, in most cases, coincident with a change of atomicity. Thus iron, in the ferrous

salts, has the equivalent 12.0; in the ferric salts, 20.1; and, since the refraction-equivalent of iron in potassic ferridcyanide is 11.7, the view suggests itself that the metal is here in the same condition as in the ferrous salts. Great anomalies present themselves in the case of oxygen. Its equivalent, in many compounds, is 2.9; but, in others, it comes down to 2.1; and, in some cases, as in some sulphates and phosphates, it would seem to be a negative quantity. This points to the conclusion that oxygen has the power of greatly modifying the action on light of those bodies with which it is combined in a high proportion.

On looking over the above list, one is struck by the identity of the equivalents of those elements which have the same, or nearly the same, atomic weight. This property is still more prominent when the specific refractive energies of the elements, instead of their refraction-equivalents, are considered. The following pairs may serve as illustration:—

Iron ..	0.214	Aluminium	0.307	Bromine	0.191
Manganese	0.222	Chromium	0.305	Iodine ..	0.193

But the most suggestive comparison is that between the specific refractive energy and the combining proportions of those metals that form salts not decomposable by water. By combining proportion is meant the actual amount which will combine with a certain quantity of a salt radicle. A few of these metals may be quoted:—

	Specific refractive energy.	Combining proportion.
Hydrogen ..	1300	1
Aluminium ..	307	9.1
Calcium ..	260	20
Iron ..	214	28
Sodium ..	209	23
Potassium ..	207	39.1
Copper ..	183	31.7
Silver ..	125	108
Lead ..	120	103.5
&c.		

The regularity in the decrease of the numbers in the first column, and the corresponding increase in the second column, would suggest that the combining proportions of silver, lead, &c., ought to be halved, in order to bring those elements to about their right places in the list. There is, further, a remarkable coincidence between the power of a metallic element to refract the rays of light and its power to saturate the affinities of other bodies (of course, it must be borne in mind that a small combining proportion means a high saturating power).

Dr. THUDICHUM made a communication "*On Kryptophanic Acid*," a normal ingredient of human urine.

The substance can be obtained in various ways from the primary material. One is to treat the urine with an excess of milk of lime to concentrate the mixture, filter it from the gypsum to acidify the filtrate, and evaporate it to syrupy consistency. This syrup, after having been filtered from the salt-cake, is treated with strong alcohol, which separates the lime-salt of the kryptophanic acid as a dark, flaky mass. The impure lime-salt is dissolved in water, and mixed with a solution of neutral lead-acetate: a dark-coloured precipitate is formed, from which the mother liquor is filtered. The filtrate, containing lead-kryptophanate, is treated with strong alcohol, whereupon white lead-kryptophanate is deposited in flakes, from which the acid is liberated by sulphuretted hydrogen.

Kryptophanic acid is an amorphous, gummy mass, transparent, and nearly colourless. It forms salts with the alkalis, the alkaline earths, and many metals. In the aqueous solutions of its earthy salts, a precipitate is produced by mercuric nitrate (the ordinary analysis for urea by this reagent is thus shown to be liable to error). The determinations of the free acid, as well as of its salts, have led to the formula  $\text{C}_5\text{H}_9\text{NO}_5$ , and shown the acid to be dibasic; in some cases, however, it may be taken as tetrabasic, and then its formula would be  $\text{C}_{10}\text{H}_{18}\text{N}_2\text{O}_{10}$ .



For the next meeting, on March 17th, the following papers are announced:—"On Artificial Alizarine," by W. H. Perkin, F.R.S.; and, "On the Combinations of Carbonic Acid with Ammonia and Water," by Dr. Divers.

# MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, February 22, 1870.

J. P. JOULE, D.C.L., LL.D., F.R.S., &c., President in the Chair.

THE PRESIDENT referred to the observations he had made in former years on the progressive rise of the freezing point of one of his thermometers, published in the Proceedings for April 16, 1867. He had made a further observation on the 12th February inst., and found that a rise, which though very small was unmistakable, was still taking place after a lapse of time of 26 years since the bulb was blown. The results are as follow in indications of the thermometer, calling the first observation in April, 1844, zero. 12.9 divisions of the thermometer correspond to one degree Fahrenheit.

April, 1844	..	..	..	..	..	0
Feb., 1846	..	..	..	..	..	5.5
Jan., 1848	..	..	..	..	..	6.6
Feb., 1853	..	..	..	..	..	8.8
April, 1856	..	..	..	..	..	9.5
Dec., 1860	..	..	..	..	..	11.1
March, 1867	..	..	..	..	..	11.8
Jan., 1868	..	..	..	..	..	11.92
Feb., 1870	..	..	..	..	..	12.02

Dr. F. CRACE CALVERT, F.R.S., stated that he did not intend to read a paper on *artificial alizarine*, some of the facts he was going to bring before the notice of the meeting being well known to his colleagues, the chemists of this district, but he hoped it might be interesting to the general members of the Society to have an idea of the progress that had been made during the last few months in the production of this substance. They were aware that alizarine was the essential colour-giving principle of the madder root. Every cultivated mind in Lancashire ought to be acquainted with each step made in the artificial production of this dye, owing to the immense capital involved in the cultivation of the madder plant in the working of it up in this country, as well as the revolution it will effect in our commercial relations and the important new branches of manufacture it will create.

It was well known to the members of this Society that about 12 months ago Messrs. Graebe and Liebermann had discovered a method of producing alizarine from a coal-tar product, which up to that time had attracted very little attention, even in the scientific world, viz., anthracene,  $C_{14}H_{10}$ , and that by oxidation they transformed it into anthraquinone,  $C_{14}H_8O_2$ , which in turn was changed into bibrom-anthraquinone,  $C_{14}H_6Br_2O_2$ , this being converted into alizarine,  $C_{14}H_8O_4$ , by the addition of two equivalents of oxygen and the formation of two equivalents of hydrobromic acid.

It was felt by all chemists that this discovery was one of great importance, though it was too complicated to be commercially useful, but the Gordian knot being now cut, the commercial production of artificial alizarine was merely a question of time, and what he would now relate showed the marked progress which had been made toward this end.

There were already three patents published; and one process, the details of which are kept secret, is being worked by Messrs. Meister, Lucius, and Co., of Höchst, near Frankfort. The patents are those of Messrs. Brännen and of Gutzkow, of Messrs. Caro, Graebe, and

Liebermann, and Mr. W. H. Perkin. It was curious to notice that the patent of Messrs. Caro was dated the 25th of June last, and Mr. Perkin's the 26th of the same month; and that all these patents effect the same purpose by simply employing different oxidising agents. Messrs. Brännen and Gutzkow oxidise the anthracene into anthraquinone by means of the nitrate of protoxide of mercury, Messrs. Caro by peroxide of manganese, and Mr. Perkin employs oxanthracene, and then all by further processes, which are nearly the same, convert anthraquinone into alizarine.

As it might be interesting to many of the members to have an outline of one of the methods employed, he would therefore describe a process detailed in the specification of Messrs. Caro, Graebe, and Liebermann. One part of anthracene is heated with four of sulphuric acid, of specific gravity 1.845, for three or four hours, to a temperature of 212° F., and then for about an hour at 300°. The mixture is allowed to cool, and to it is added water equal to three times the weight of the anthracene employed, and manganese equal to four times that weight.

The whole is boiled for three hours and milk of lime added, which gives rise to a deposit consisting of the excess of lime and manganese used and protoxide of manganese, while there remains in solution a double sulphate of anthraquinone and lime. This solution is now acted on by carbonate of soda in slight excess, carbonate of lime separates, and the salt of soda thus produced is evaporated to dryness. This solid mass is then mixed with two or three parts of caustic potash or soda and a small quantity of water, and the whole heated under pressure in suitable vessels at a temperature of 350° to 500° F. for one hour, when the anthraquinone is further oxidised, and converted into alizarine. The alkaline mass, on cooling, is dissolved in water, and sulphuric or acetic acid added in slight excess, when an orange-yellow, flocculent substance precipitates, which, when properly washed and dried, is artificial alizarine.

If this process can be carried out on a practical scale (and there is no doubt that it will be, under the direction of such clever chemists as Messrs. Perkin, Caro, and others), we may then fairly consider the production of artificial alizarine as having reached the sphere of commercial application; though I may add, from personal experience, that some time must elapse before it can be manufactured in quantities sufficient to affect the present applications of madder, garancine, Schunck's commercial alizarine, &c.

There is another great difficulty yet to be overcome before the artificial alizarine can become a commercial article, that is, the obtaining of anthracene in larger quantities, and this question is of some importance to us, England being the great tar producing country. Anthracene does not appear to exist in greater proportion than one in a thousand of tar, and is only liberated or produced during the latter part of the distillation of the tar. In fact, if the distillation be stopped so as to leave a very soft pitch, the oils obtained give little or no anthracene. If, on the other hand, it is carried on so as to get 10 or 15 per cent more oil off, there remains a hard pitch which has little or no value at the present day, the quantity of anthracene obtained varying very much according to the nature of the coals employed in the production of the tar, ranging from 1½ to 8 per cent of the heaviest oils separated; it will scarcely be worth the while of the tar distiller to depreciate the value of one of the staple articles of his trade to produce it, and even when the heavy oil is obtained the separation of the small quantity of anthracene it contains, and its purification for use according to the above patents, will yet require much time and research. It is well known to all who have worked on the coal-tar products that each well-defined compound is mixed with homologues which renders its separation and purification a work of extreme difficulty; thus aniline is mixed with picoline and several other alkaloids, benzol with toluol and other hydrocarbons,



carbolic acid with cresylic and other acids, and anthracene is also mixed in a similar manner with homologous compounds.

The mere distillation and filtration of the solids obtained and their hot or cold pressing, or even their sublimation, do not effect the complete purification of the substance. The purest product I have been able to obtain on a moderate commercial scale has contained, when cold pressed about 40 per cent, and when hot pressed about 70 per cent of anthracene. One of the chief difficulties in its preparation is the fact of its great solubility in its liquid homologues at a moderate temperature, thus an oil, at 40° or 45° F., will yield a comparatively large quantity of anthracene by filtration, but if its temperature be raised to 70° or 80°, the anthracene will be completely dissolved.

I am aware that it has been proposed to distil soft pitch so as to obtain the volatile products that are given off in coaking it, but the expense, difficulty, and danger of such an operation are such that I doubt if they can be overcome so as to produce anthracene of comparative purity on a commercial scale.

Papers have been published respecting the identity of the alizarine produced by the process of Messrs. Meister, Lucius, and Co., with natural alizarine, by Dr. Schunck, Professor Bolley, and Messieurs Emile Kopp, Camille Kœchlin, La Fraisse, G. Wallace Young, and J. Christie. The opinions of these chemists vary. Dr. Schunck and Professor Bolley consider it identical, the other gentlemen considering it not identical, some of them maintaining it to be a mixture of purpurine and alizarine.

The product made according to the patents mentioned I have not had an opportunity of examining, nor have I seen any papers on the subject in any of the scientific journals which have reached my hands; but as doubtless it will shortly be before the public, I shall take an early opportunity of laying before the society the results of my own experience as well as those of others.

In conclusion, I think many years must elapse before artificial alizarine can replace madder and its preparations in all their varied applications in calico printing, but ere long the purity of the substance, artificially obtained, may prove of great service to the calico printer, by enabling him to produce, at a cheaper rate than now, certain styles of prints as well as new styles and effects.

Specimens of anthracene, artificial alizarine, and dye fabrics were exhibited.

Dr. SCHUNCK, F.R.S., remarked that the practical success of the new process would in a great measure depend on the price of the raw material, anthracene, and on the amount of colouring matter to be obtained from it. The process itself was, however, as far as the few experiments he had made allowed him to judge, a very simple and easy one, requiring the use of no costly materials. He was convinced himself that the artificial product was identical with the natural alizarine of madder, the only difference being that the former was generally contaminated with some impurity which prevented its crystallising easily. Purpurine was not formed along with alizarine, as had been supposed. He also exhibited to the meeting some specimens of Turkey-red dyed with artificial alizarine, which had been sent to him by Mr. Perkin, and stated that the latter had already manufactured several tons of the new product.

In connection with this subject Dr. Schunck referred to a notice contained in the CHEMICAL NEWS (vol. xxi., p. 81), giving an account of a process for preparing pure alizarine from Turkey-red dyed cotton. The author, M. Schützenberger, does not state that the process is new, though he seems to claim it as his own. Almost the same process was, however, described many years ago by Dr. Schunck, who claims, indeed, to have been the first to point out that Turkey-red, madder pink, and all the finer madder colours are simply compounds of alizarine and fatty acids with bases. The experiments on which this conclusion was founded were described in the edition of "Ure's Dictionary

of Arts," published in 1859, under the heads of "Madder" and "Turkey-red," but the experiments themselves were made at a much earlier date.

(To be continued.)

## NOTICES OF BOOKS.

*A Dictionary of Scientific Terms.* By P. AUSTIN NUTTALL, LL.D., Editor of "The Classical and Archæological Dictionary," "Standard Pronouncing Dictionary," and numerous educational works. London: Strahan and Co., 1869. 8vo.; pp. 325.

THE object of this work is "to render the language of science intelligible not only to the professional student but to the general reader." It has been specially arranged with a view to educational purposes, and to further the working of the revised code which was framed a short time ago by the Committee of the Council for Education. Dr. Nuttall's book is dedicated "By special permission to the Right Honourable Robert Lowe, Chancellor of Her Majesty's Exchequer, and the eloquent representative of University College (*sic*?), London." Now, the Right Honourable Robert Lowe is not only Chancellor of Her Majesty's Exchequer, but Master of Her Majesty's Mint, and in these combined capacities he is at this moment preparing a Bill to consolidate and amend the laws relating to the coinage and the Mint. With such a subject, what can be more natural than that he should turn for some piece of technical or scientific information to the work so recently, and "by special permission" dedicated to him, and of which it may be reasonable to suppose he possesses an elaborately bound and large-paper copy? He seeks for—what shall we say?—*metals*, as most *à propos* to his new position, and at page 17 of the introduction, he reads, "A few of the principal metals are here given in alphabetical order:—

Antimony.	Copper.	Manganese.	Silver.
Arsenic.	Gold.	Mercury.	Steel.
Bismuth.	Iridium.	Nickel.	Tin.
Black-lead.	Iron.	Ochre.	Tungsten.
Brass.	Lead.	Pewter.	Zinc."
Cobalt.	Magnet.	Platinum.	

"I had no idea," muses the Right Honourable gentleman, "that black-lead and ochre were reckoned among the principal metals, but science is making wonderful strides now-a-days." Next he specialises, and turns to gold, silver, copper. Gold is found to be "the most valuable and ductile of all the metals, and is used by all civilised nations as a standard of value;" it "unites with most other metals, and with sulphur, ammonia, &c." "Silver is one of the fifty-five simple or elementary bodies, and included in the sub-division termed metals nearly white." "The ores of copper are very numerous, the principal being sulphuret of copper and iron (iron pyrites), and sulphuret of copper (nitrous copper ore)." Let us sincerely hope (and, if necessary, memorialise the Right Honourable gentleman on the subject) that Mr. Lowe will not ordain this the text-book of the Treasury, will not have it employed by candidates for Civil Service appointments, will not get up his chemistry and metallurgy and general science from it. Now, if a new or modified code of taxes were framed on its authority, we do not know what would become of us, had we not Dr. Playfair in the House to see fair play in regard to all that relates to *scientia immutabilis*.

Now we fully recognise and admit the difficulty and labour of compiling such a work as that before us. We wish to make every allowance for this difficulty, and we assure Dr. Nuttall we would always rather praise than blame. If his soul be in law or literature, while his body, for the time being, is in science (like the man in the old Spanish song whose body was in Segovia while his soul was in



Madrid), we have the more sympathy for him. He has told us in the preface that "occasional omissions or oversights may possibly be discovered," and he has asked "every indulgence from a generous public." We will respect this; it may be thought we have been seeking omissions and errors; now on our word of honour we will open the book several times at random, with our eyes shut, and thereupon criticise without favour and with our eyes open. "CRATER, the mouth of a volcano. In *astrology*, a constellation in the southern hemisphere. CRETINISM a species of *idiotism* with which the goitrous inhabitants of the alpine valleys are afflicted." FLUORIC ACID = 3 atoms of fluorine + 1 of boron, equiv. 66.98." (The last example p. 154, left-hand column). "CHLORIDE OF POTASH, a valuable compound prepared by passing chlorine gas into a mixture of 1 lb. of caustic lime, and 1 lb. of potash, with 8 lbs. of water." O! Dr. Nuttall, hard worker and earnest though you may be, we must tell you that this is not the science of to-day. We do not quote Werner for geology, Hoblyn for chemistry, Howard for meteorology, Craig for mathematics, or "the intelligent author of 'The Traveller's Remembrancer,' for anything whatsoever. We neither know their names, nor recognise their authority. We do not use such terms as *hydroguret*, *electrology*, *fluat* of lime, *hydropneumatic*, *physicologist*, no do we include hydrostatics in hydrodynamics (p. 184). This is partly the science of another age, partly the science of no age at all.

And now, before leaving the work, let us return once more to the introduction. It is headed by what we suppose is the key-note of the work, the phrase which Colonel Newcome loved to quote, which the Padre Cura of Guadarrama persisted in attributing to Cicero, and which comes to most of us at an early age *viâ* the latin grammar, and the syntax therein, and the troublesome nominative to the verb:—

"Didicisse fideliter artes  
Emollit mores, nec sinit esse ferus."

But why has our author omitted the "*Ingenuas*?" Injured shade of Ovid, you have our sympathy. Are not the arts of which he treats ingenuous? We feel bound to confess that they could not be learnt faithfully from the work before us if they were, so perhaps it is as well to maim the lines altogether; and we would further (with apologies to the reader) state that the learning of the arts, especially those appertaining to the extracts given above, out of this book has quite a reverse effect to that conveyed by the Ovidian maxim, for it makes us exceedingly *ferus*. Not far removed from "Didicisse, &c.," in the Latin grammar, our author may remember another phrase, which he may be inclined to say to us after perusing the above remarks: "Vos damnâstis; (*quasi dicat præterea nemo*)" but we assure him in this case the nominative of the pronoun need not be expressed; it is not we alone who have condemned; we must say *Damnauerunt* without the pronoun, and we regret it for his sake.

## MISCELLANEOUS.

The Royal Society.—The president gave the first *soirée* of the season on Saturday evening last at Burlington House. There was a large attendance of visitors, and a number of objects of scientific interest were exhibited. Mr. Browning's display included an improved large automatic electric lamp, in which the carbon points are drawn asunder, and their distance regulated solely by the force of the electric current employed; transparent stereograms on glass, of a globe of the planet Mars; water-colour drawing of Jupiter, exhibiting the ochreish-yellow or tawny belt, now visible near the equator of the planet; arrangement of spark condenser, in connection with a condenser in box to take the Leyden jar, the upper part to unscrew and pack in lid of box—the advantages are perfect insula-

tion, large surface in small space, freedom from liability to fracture, portability; bright cross micrometer for measuring the position of lines in faint spectra; by using this instrument only the cross is seen illuminated, and the light of the spectrum is unimpaired; spectrum of pure gold, shown in a chemical spectroscope, this instrument has been arranged specially for use in a laboratory, the prism is provided with a very closely fitting cover, and the prism can be removed from the plate and a prism of any other substance introduced instead, for the convenience of taking refractive indices and dispersive powers. The India Rubber Company showed the Leclanché battery. The vacuum tubes shown by Mr. Apps attracted considerable attention. Mr. Ladd showed his new form of electric lantern recently described in these columns. This maker also showed a new form of micro-spectroscope. Mr. W. Chandler Roberts, the chemist to the Mint, exhibited remarkable specimens of electro-deposited iron, prepared by M. Jacobi, of St. Petersburg, and himself. The metal is sufficiently hard to scratch glass. The application of hard iron plates for printing purposes was illustrated by some extremely fine proofs. This material possesses great advantages as an art material. Specimens of electro-iron converted into steel were also shown.

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopaedic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, with their copious indices, will, therefore, be equivalent to an English edition of the "*Jahresberichte*."

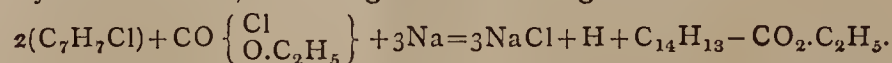
NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

*Comptes Rendus des Séances de l'Académie des Sciences*, February 21, 1870.

This number contains the following original papers and memoirs relating to chemistry and allied sciences:—

Cause of the Electro-Capillary Currents in the Bones, Nerves, and Brain.—E. Becquerel.—A physiologico-physical treatise.

Synthesis of Aromatic Acids.—A. Wurtz.—The substance mainly described in this paper is dibenzyl-carboxylic acid,  $C_{15}H_{14}O_2$ , obtained by the action of sodium upon chloride of benzyl and chloroxycarbonic ether, according to the following formula:—



This acid is almost insoluble in cold water, somewhat soluble in boiling water, and very readily soluble in alcohol and ether. It is a solid substance; it fuses at  $84^\circ$ ; at a very high temperature, it boils, and distils over without alteration. The salts of this acid crystallise with difficulty; the calcium salt yields, when submitted to dry distillation along with excess of lime, a mixture of dibenzyl and stilben.

\* Stability of the Normal Propylic, Butylic, and Amylic Alcohols, considered as Chemical Species (*Espèces Chimiques*).—J. Pierre and E. Puchot.—The authors have studied chiefly—The temperature of ebullition; the specific gravity at  $0^\circ$ , and at various other temperatures; the index of refraction at one and the same temperature; and the action of polarised light of the substances just named. The results are given in the shape of tabulated forms.

Report on the Labours Concerning Ozone.—Aug. Houzeau.—From this very lengthy paper, we quote an almost unknown fact—viz., that, as far back as the year 1785, Dr. van Marum, at Haarlem, noticed that oxygen was curiously modified after it had been submitted for some time to the passage of electric sparks. He proved that the gas thus acted upon oxidised mercury very rapidly at the ordinary temperature of the air; and he also particularly noticed the peculiar odour the gas had acquired. The author quotes the following new method for the preparation of ozone:—Binoxide of barium is treated for this purpose with sulphuric acid; the oxygen given off is strongly ozonised. It is also observed that the presence of ozone in air, although very probable, has not been hitherto undeniably proved, while the presence in air of various other substances, among these, hyponitric acid, cannot be denied; and a great difficulty arises from the similarity of the reactions with the same reagents exhibited by these bodies. This paper is a complete monograph on ozone.



**Researches on the Artificial Digestion of Amylaceous Matter by the Aid of Maltine.**—L. Contaret.—Maltine is obtained from barley-malt by steeping that substance in tepid water. The substances thus extracted from malt, and collectively called maltine, or vegetable diastase, has been applied by the author for experimenting upon starchy substances, and converting these, at about 38°, and under the influence of water, into dextrine and sugar (glucose). The author's maltine is very similar to, if not identical with, the much-vaunted malt extract.

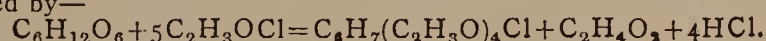
**Method adopted by the late L. Foucault to Recognise whether the Surface of a Mirror is Rigorously Parabolic.**—A. Martin.

**A New Kind of Thermometer.**—A. Lamy.—Some time ago, this author proposed a pyrometer based upon the dissociation of carbonate of lime; he now proposes to apply ammoniacal chloride of calcium, which gives off ammonia at low temperatures. The instrument is to be connected with a manometer, which will record the temperature. The contrivance is to be especially adapted to record the temperature at different depths under the surface of the soil. M. E. Becquerel and others very properly observe that better and far more accurate means for accomplishing this purpose exist already, and are daily successfully employed.

**Some Observations on the Diamond Found at Blaschowitz (Bohemia).**—A. Schafaritz.—In order to settle all doubt about the true nature of this diamond, the author has burned, in a current of oxygen, and with suitably-arranged apparatus, a sufficient quantity of this stone to prove that it is completely consumed, yielding only carbonic acid. We, moreover, learn from this paper that the geological conditions of the locality where this stone has been found bears a great resemblance to the geological conditions of that portion of the Brazil where diamonds are constantly sought for.

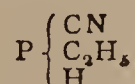
**Combination of the Hydracids with Bromated Ethylen and Propylen.**—M. Reboul.

**Action of the Haloids in Free State, and of some Chlorides, upon Glucose.**—A. Colley.—After referring to the action of the haloids upon anhydrous glucose at a high temperature (80° to 112°), and, also, after having mentioned the influence of water and the action of hydrochloric acid upon glucose, the author describes, at great length, the action of chloride of acetyl upon this substance when placed in a sealed tube; the result is the formation of acetochlorhydrate, a solid body capable of crystallising, insoluble in water, and soluble in alcohol, ether, and chloroform. On being submitted to elementary organic analysis, results were obtained leading to the formula  $C_6H_7(C_2H_3O)_4O_5Cl$ . Its mode of derivation from glucose is represented by—



This formula is exactly reproduced from the original.

**A New Phosphated Compound.**—L. Darmstädter and A. Henninger.—While causing an ethereal solution of phosphuretted hydrogen to act upon chloride of cyanogen, the authors have obtained—



a solid substance, crystallising in rhombic-shaped crystals, fusing at about 50°, and volatilised without decomposition. This cyanethylphosphide is readily soluble in water, alcohol, and ether, and its formation is elucidated by—



**Chemical and Therapeutical Researches of the Thermo-Mineral Water of the Solfatara of Pouzzoles (Italy).**—S. De Luca.—This mineral spring, met with near Naples, is remarkable for containing arsenic, free sulphuric acid, and a number of other substances, amounting, per litre, to—Sulphuric acid (calculated in anhydrous state), 1.473 grms.; chlorine, 0.0085; protoxide of iron, 0.1105; lime, 0.1101; magnesia, 0.0225; potassa, 0.017; ammonia, 0.0135; alumina, 0.335; silica, 0.315; soda, manganese, arsenic, and nitrogenised organic matter, traces. As regards the presence of arsenic, the author states that the volcanic fumarola, close to the spring, yields vapours among which the presence of sulphide of arsenic is readily made visible, by holding, for a moment, any cool substance, even paper, at the place whence they exude to obtain crystals of sulphide of arsenic. This water yields, on evaporation, excellent alum, and is therapeutically applied, internally as well as externally. The temperature is not mentioned.

February 28, 1870.

This number contains the following original papers and memoirs relating to chemistry and allied sciences:—

**Modifications Produced by Magnetism in the Light Emitted by Rarefied Gases Enclosed in so-called Geissler Tubes.**—Rev. A. Secchi, S.J.

**New Studies on Propylic, Butylic, and Amylic Aldehydes.**—I. Pierre and E. Puchot.—Pure propylic aldehyde is a limpid, colourless liquid, boiling at 46°; it emits a suffocating odour; is so prone to oxidation, that it is difficult to obtain it free from propionic acid; reduces nitrate of silver readily; sp. gr. at 0°, 0.8327, at 32°, 0.7906. Butylic aldehyde is also a limpid, colourless liquid, which readily reduces salts of silver, and boils at 62°; sp. gr. at 0°, 0.8226, at 27.75°, 0.7919. Amylic aldehyde, also a liquid, boils at 92.5°, and is very readily converted, by oxidation, into valerianic acid; sp. gr., at 0°, 0.822, at 4.34°, 0.779.

**Determination of the Form of Our Globe by Experimental Means.**—G. Lambert.

**Note on the Physical Condition of Bodies.**—F. Lucas.—Both these papers are physico-mathematical essays.

**Observations made of a Meteorite at the Observatory at Paris.**—MM. Wolff, Adré, and Capitanes.—A concise account of a meteorite seen on the 26th of February last, at 9.35 p.m.

**Foucault's Method of Autocollimation, and its Application to the Study of Parabolic Mirrors.**—A. Martin.

**Divers Orders of Spectra of the Simple Bodies.**—Dr. Dubrunfaut.

**Solution of Reducing Gases by Molten Iron and Carburets of Iron when in Liquid State by Fusion.**—H. Caron.—The author of this paper states that the spirting of fused cast-iron is not due, as has been stated by M. H. St. Claire-Deville, to the solution (or absorption) of certain gases in these metals while at a high temperature, but is the result of a peculiar reaction which continues until the metal is completely solidified. M. H. St. Claire-Deville replies that, whether the gas be oxide of carbon or hydrogen mixed, or whether it be oxide of carbon only, it is the gas which causes the spirting, and often even the projection, of large quantities of molten metal to great distances.

**Oxidation of Iron.**—F. C. Calvert.—This paper contains a full description of a series of experiments made with the view to establish precisely the causes of and conditions under which iron rusts. The author comes to the conclusion that the carbonic acid, as well as the watery vapour, contained in the atmosphere concur jointly in causing iron to rust. Prof. Chevreul makes the following observations on this subject:—Claude Bourdelin was the first who observed (in 1683) that ammonia is formed when aerated water acts upon steel. In 1720, E. F. Geoffroy found that iron rust formed in the air contains moisture and ammonia. Vanquelin found ammonia in the specks of rust formed upon a chopper, of which it was suspected that it had been used for murdering somebody; the presence of ammonia in iron rust should, therefore, be cautiously dealt with in medico-legal questions. According to Dr. Calvert, pure iron does not decompose pure water at the ordinary temperature; and if this is correct, the fact observed by Prof. Chevreul, that the white hydrated protoxide of iron decomposes water, becomes more interesting.

**Dissociation of Ammoniacal Compounds.**—F. Isambert.—The author describes a series of experiments made with anhydrous double salts of ammonia, zinc, and cadmium sulphates, and the dissociation of these by heat (100°), aided by vacuum. The general conclusion arrived at by the author is that, by the action of ammonia gas upon the chlorides or sulphates of the metals alluded to, there is, independently of the chemically-combined ammonia, some of that gas absorbed in the same manner as charcoal is capable of doing. The compound  $CdOSO_3.3NH_3$  is to be considered as made up of  $(CdOSO_3.NH_3)_2NH_3$ .

**Aurora Borealis and other Meteorological Phenomena Seen and Observed in Piedmont on January 3rd, 1870.**—Rev. P. Denza, S.J.

Cosmos, February 26, 1870.

**The Newton-Pascal Forgeries.**—The forger of these and other documents (a number of 27,000, only taking into account those purchased by M. Chasles, who paid £5600 for the same) is now on his trial before one of the tribunals of Paris.

**Discovery of Coal in the Brazil.**—R. von Brause states that he has discovered coal of very good quality in the Province of Santa Catharina, near Ararangua. The seam which crops out has been explored for a distance of some 30 miles, and found to be of an average thickness of 1 metre. This coal has been thoroughly tested and analysed by Dr. Netto, of Rio de Janeiro, and is interesting as one of the very few instances of a true coal occurring in a recent geological formation, although in the United States and in Hanover (on the very borders of the Netherlands), two or three such occurrences are on record. The coal here alluded to is an excellent quality of gas coal.

**Curious Instance of Spontaneous Combustion of the Human Body.**—Dr. Bertholle.—This paper relates a duly authenticated case of this rare phenomenon. The victim, a woman aged 37 years, was a confirmed drunkard. Many of our readers will recollect, perhaps, that Prof. Liebig wrote a paper on this subject some years ago, when the medico-legal question arose concerning the death of a noble lady in Germany.

**Phosphide of Calcium Applied to Life-Buoys.**—F. Silvas.—Experiments have been made at Toulon to try to attach to life-buoys another floating body provided with phosphide of calcium, which, on becoming wet, gives off spontaneously combustible phosphuretted hydrogen, thus emitting light to guide the man who might have fallen overboard and be in search of the life-buoy.

Revue Hebdomadaire de Chimie, February 17, 1870.

**Modifications in the Mercurial Air-Pump.**—Messrs. Alverg-niat, Frères.—The improvement here alluded to cannot be well understood without reproduction of the cut; but there is no doubt that this modification will soon be generally adopted, since it greatly aids the efficiency of this apparatus.

**Quality of the Kerosen Oil as Met with and Sold at New York.**—C. J. Chandler.—The first portion of a report to the Imperial City's Board of Health on this subject.

**Carbonisation of Dry (Non-Caking) Coal.**—E. Péricot and T. Appolt.—This paper is a first instalment on the means by which coke of good quality may be made from *houille maigre*—that is to say



non-caking coal. This property may be due to either excess of carbon (as in anthracite), excess of oxygen (as, for instance, in the coal from Saarbrück, which contains 17 per cent of that element), or to excess of ash (as, for instance, the Boghead and some other Cannel coals); but, as regards the latter, there are other causes in play for preventing them from caking, and, among these, the water they contain in a peculiar manner.

February 24, 1870.

This number contains the continuation of the following original papers:—

**Quality of the Kerosene Oil as Sold at New York.**—Prof. C. J. Chandler.—The specific gravity of the native petroleum varies from 0.773 to 0.910; and the average composition of crude Pennsylvania petroleum is, in 100 parts—Gazoline (sp. gr., 0.744), 10 parts; naphtha (sp. gr., 0.752), 10 parts; oils fit for burning and lubrication, 76 parts, varying in sp. gr. from 0.844 to 0.760. The paper further contains a large amount of information concerning the American regulations for the sale and testing of petroleum, and gives a tabulated review of the composition of some specimens of kerosene sold at New York, from which it appears that some kinds contain no less than 90 per cent of the very volatile oils, while in other instances, again, the quantity of the latter is *nil*.

**Carbonisation (Coke Manufacture) of Non-Caking Coal.**—The main point here brought forward is the well-known washing process, whereby the earthy constituents of the coal are removed, and, having become decreased in quantity, admit of the agglomeration of the organic matter when heat is applied. The admixture of a good quality of caking coal is advocated for obtaining coke from anthracite.

**Holtz's Electrical Machine.**—M. I. Mène.—This complete description of this machine, as improved by M. Bouchotte, is accompanied by a couple of woodcuts.

*Annales de Chimie et de Physique*, January, 1870.

This number contains only two original memoirs:—

**Estimation of Carbon in Cast-Iron, Wrought-Iron, and Steel.** M. Boussingault.—The paper, a lengthy essay on this subject, opens with the quotation of the results of an analysis of white cast-iron smelted with charcoal at Medellin, in New Grenada. In 100 parts, this substance contained:—Combined graphite, 4.40; silicium, 0.75; phosphorus, 0.07; sulphur, traces; nitrogen, 0.0118; manganese, 0.84; chromium, 1.95; vanadium, traces; iron, 92.50. The paper contains the following sections, headed—Attacking iron by the dry process—*i.e.*, with bichloride of mercury; attacking iron by the wet process; estimation of carbon in cast-iron, wrought-iron, and steel.

**Temperature of Flames, and on Dissociation.**—E. Vicaire.—This is the first instalment of a lengthy memoir on this subject, accompanied by several engravings.

February, 1870.

This number contains continuation and end of last-named memoir, and—

**Migration of Nitrogen during the Process of Beet-Root Sugar Manufacture.**—A. Renard.

**Optical and Crystallographical Researches on the Clino-Rhombic Form of Tungsten.**—M. des Cloizeaux.

**Simultaneous Estimation of Carbon, Hydrogen, and Nitrogen in the Elementary Analysis of Organic Substances.**—Th. Schlösing.—This excellent memoir cannot be well understood without the reproduction of the several woodcuts annexed to it.

**On the Effect Motion has upon the Vibrations of Sound, and on the Length of the Wave of the Rays of Light.**—H. Fizeau.

**Regulator for the Use of Gas in Chemical Laboratories.**—Th. Schlösing.—Cannot be usefully abstracted without the reproduction of the woodcuts.

**Researches on Camphor and some of its Derivatives.**—H. Baubigny.—This is the first portion of a lengthy monograph on this subject, divided into the following sections:—Introduction, treating briefly on the researches made on camphor by various authors; action of sodium upon camphor; action of water upon sodium products, and formation of borneol; action of the bromides and iodides of the radicals of the diatomic alcohols upon the sodium derivatives from camphor.

*Moniteur Scientifique*, No. 317, March 1, 1870.

Contains the following original papers:—

**Oil Refining.**—M. de Keyer.—This process is equally applicable to all fat, or fixed oils. Take, for 100 kilos. of oil, 600 grms. of liquid ammonia, diluted with the same quantity of water; the mixture is vigorously stirred for about half-an-hour, and next left quietly standing for three days, care being taken to keep the vessel containing the mixture well closed. The oil having been decanted from the sediment (which is applied for soap-making), is ready for use after washing with water and filtration.

**Researches on Molasses, and on the Divers Processes of Sugar Refining as Applied in Paris.**—Dr. Dubrunfaut.—A lengthy monograph, of interest chiefly to sugar refiners.

**Direct Application of Suint to the Manufacture of Cyanides.**—Léon Sauvage.—In reference to what was stated in this periodical (see abstract, vol. xxi., p. 71), this author writes to say that he obtained, on the 30th of December, 1864, a *brevet d'invention* for this invention,

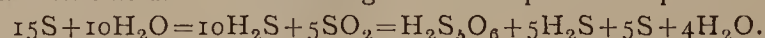
and that this *brevet* is now public property. The author's object is to state that his is the right of priority.

*Journal für Praktische Chemie*, No. 18, 1869.

This number contains the following original papers and memoirs:—

**Preparation of Pure Titanic Acid and its Separation from Zirconium and Iron.**—G. Streit and B. Franz.—The first section of this paper is devoted to a comparative review of the methods hitherto in use for the disintegration and solution of minerals containing the substances named above. The preparation of titanic acid by the method suggested by the authors, consists in fusing rutile, first, with three times its weight of carbonate of potassa at a high temperature in fire-clay crucibles. The fused mass is poured out on a piece of sheet-iron, so as to form, on cooling, a thin cake; this is next ground to powder, and exhausted with water, and, after removal of the silica, treated with crude hydrochloric acid, no heat being at first applied. The several operations of filtration and washing by decantation having been got through, the titanic acid is precipitated by means of a mixture of acetic acid and dilute sulphuric acid, and boiling, by the aid of steam, for some ten hours. The separation of zirconia from titanic acid is discussed at great length; the authors experimented with a solution containing 4.23 grms. of  $\text{TiO}_2$ , 0.188 of  $\text{FeO}$ , and 0.062 of  $\text{Fe}_2\text{O}_3$ , and added thereto the sulphuric acid solution of 0.613 gm. of zirconia. To the solution was then added its own bulk of acetic acid, and the liquid boiled; all the titanic acid was hereby precipitated, while iron and zirconia remained in solution. From the filtrate the two latter substances were precipitated by ammonia, and, after having been collected upon a filter, washed, dried, ignited, and weighed, the iron was estimated in the re-dissolved substance volumetrically.

**Formation of Sulphuretted Hydrogen from Water and Sulphur.**—J. Meyers.—While experimenting on the boiling-point of sulphur, the author detected the presence of sulphuretted hydrogen; and this induced him to make, purposely, an experiment whereby steam was made to pass over sulphur kept boiling in a tube. A large quantity of sulphuretted hydrogen was formed, and, simultaneously, pentathionic acid. The following formula explains the process:—



This number contains the notice that Dr. H. Kolbe has been appointed chief editor of this journal, which will in future appear in fortnightly numbers, excepting that during the months of August and September no issue takes place; but, exceptionally, the journal will be published during these months in the current year, to make up for backward appearance during the first two months of 1870.

*Revue des Cours Scientifiques de la France et de l'Etranger*, February 26 1870.

This number does not contain any papers relating to chemistry or sciences allied therewith.

## NOTES AND QUERIES.

**Removing Silica.**—Can any of your readers inform me of a practical mode of removing silica from large quantities of carbonate of potassium?—W. H.

**Colours and Pigments.**—(Reply to "A Reader, Church, near Accrington.")—There are not many works on the subject you refer to. One of the best is "Lehrbuch der Farben Fabrikation, &c., &c.," von T. G. Genteb (Brunswick: Vieweg and Son, 1860). As to the manufacture of blood and egg albumen, you mean, of course, the preparation of these articles in dry state, fit for preservation; and, for information thereupon, we refer you, among other works, to Schützcnberger's "Traité des Couleurs," and to Persoz's "Traité de l'Impression des Tissus."

**Distilling Tar.**—Consult "Coal, Petroleum, and other Distilled Oils," by Dr. Gesner (New York, London, and Paris: Baillière, 1861; later edition in 1865), and "Industrie der Mineralöle des Petroleums, Paraffins, und der Harze," von H. Perutz (Wien, 1868); also "Chemical Technology, or Chemistry in its Applications to the Arts, &c."

## MEETINGS FOR THE WEEK.

- MONDAY, 14th.—Geographical, 8.30.  
— Medical, 8. Anniversary.  
— London Institution, 4.  
TUESDAY, 15th.—Royal Institution, 3. Dr. Rolleston, on "Nervous System."  
— Institution of Civil Engineers, 8.  
WEDNESDAY, 16th.—Society of Arts, 8.  
— Meteorological, 7.  
THURSDAY, 17th.—Royal Institution, 3. Prof. Odling, "Chemistry."  
— Royal, 8.30.  
— Chemical, 8. W. H. Perkin, "On Artificial Alizarine."  
— Dr. Divers, "On Combinations of Carbonic Anhydride with Ammonia and Water."  
— Royal Society Club, 6.  
FRIDAY, 18th.—Royal Institution, 8. Mr. J. F. Bateman, "Subway to France."  
SATURDAY, 19th.—Royal Institution, 3. Mr. Lockyer, "The Sun."



# THE CHEMICAL NEWS.

VOL. XXI. No. 538.

## ON THE REACTION OF CHLORINE ON SULPHUR SALTS.\*

THE following experiments, made some years ago in the laboratory of Owen's College, under the superintendence of Dr. Roscoe, may be of some interest as bearing on the action of chlorine and its congeners on the sulphur-acids.

In order to see how far the action of equivalent quantities of chlorine, bromine, and iodine on the same sulphurous-acid solution are comparable, solutions were prepared, one containing 5 grms. of iodine per litre, and the other such a quantity of sulphurous acid that a litre represented about 150 c.c. of the iodine solution. The exact relation between the two was determined before and after each set of experiments; and it was found that no appreciable alteration took place during the duration of any one set of experiments. A solution of washed chlorine in distilled water was also prepared, and kept in the dark, and, when required, diluted with distilled water to the required strength. The stronger solutions were weighed out in sealed glass bulbs, subsequently broken under the surface of the liquids to be acted on.

(a). Known quantities of chlorine solution were added to a measured column of sulphurous-acid solution, the latter being in slight excess. This excess was then titrated by the standard iodine solution.

(b). Cl solution was added to potassium-iodide solution, and the liberated iodine treated as the chlorine in (a).

(c). Carried out as (b), but potassium bromide used instead of iodide.

(d). Bromine liberated, as in (d), by Cl and KBr; KI then added, and the iodine thus liberated by bromine treated as that obtained in (b).

By subtracting from the iodine solution equivalent to the sulphurous acid used that required for the back titration, numbers were obtained representing the amount of iodine solution equivalent to sulphurous acid destroyed by chlorine, bromine, or iodine in these experiments. Each determination was done in duplicate, frequently in triplicate; and it is noticeable that, whilst the repetitions agreed remarkably closely in all cases where iodine acted on sulphurous acid, they usually showed some little divergence in the case of bromine, and considerably more in the case of chlorine.

Care was taken in all these comparative experiments to have the total volume of liquid in each case as nearly as possible proportionate to the quantity of chlorine originally employed, so that the circumstances of dilution in any set of experiments should be approximately uniform.

The following examples show the character of the numbers obtained, the same measured volume of chlorine solution, containing 0.88 grms. of Cl per litre, being used in each instance.

Iodine representing SO <sub>2</sub> destroyed by I (liberated by Cl and KI).	Iodine representing SO <sub>2</sub> destroyed by I (liberated by Cl and KBr, and by Br thus set free, and KI).	Iodine representing SO <sub>2</sub> destroyed by Cl.	Iodine representing SO <sub>2</sub> destroyed by Br.
c.c.	c.c.	c.c.	c.c.
63.1	62.8	61.6	62.7
62.9	62.6	61.3	62.6
63.1	62.7	60.9	62.7
Mean 63.0	62.7	61.3	62.7

\* Read before the Newcastle-on-Tyne Chemical Society, Feb. 24th, 1870, continued from last number.

Similarly, with other chlorine solutions, the following mean numbers were obtained from eighteen determinations:—

Grms. of chlorine per litre of solution.	Iodine representing SO <sub>2</sub> destroyed by I (from Cl and KI).	Iodine representing SO <sub>2</sub> destroyed by Cl.	Iodine representing SO <sub>2</sub> destroyed by Br.
*7.00	49.8	44.5	51.3
0.30	57.0	56.5	56.9

The above numbers, calculated in each case to 100 parts of iodine, representing SO<sub>2</sub> destroyed by I (Cl and KI), are—

Grms. of Cl per litre of solution.	Iodine representing SO <sub>2</sub> destroyed by I (from Cl and KI).	Iodine representing SO <sub>2</sub> destroyed by I (from Cl and KBr, and from this Br and KI).	Iodine representing SO <sub>2</sub> destroyed by Cl.	Iodine representing SO <sub>2</sub> destroyed by Br.
7.00	100.0	—	89.2	103.0
0.88	100.0	99.5	97.1	99.5
0.30	100.0	—	99.2	99.9

It thus appears that the action of iodine is nearly the same, whether directly set free by Cl, or liberated by the circuitous process of evolving bromine from Cl and KBr, and then causing this bromine to act on KI, since the numbers obtained are no more different than might be anticipated from the combined effects of experimental errors, volatility of bromine, &c.; whilst the action of bromine in the two weaker solutions appears to be nearly the same as that of iodine; whereas, in the stronger solution, a larger quantity of SO<sub>2</sub> is destroyed by bromine than by iodine. Lastly, the action of chlorine appears, in the weakest solution, to be nearly identical with that of iodine, but, in the stronger solutions, differs considerably therefrom, and this difference, unlike that in the case of bromine, indicates a destruction of less SO<sub>2</sub> by chlorine than by an equivalent quantity of iodine.

From a similarly-conducted series of twenty-four determinations, the following mean numbers were also obtained as the relative actions of chlorine and iodine solutions:—

Grms. of Cl per litre of solution.	Iodine representing SO <sub>2</sub> destroyed by I from Cl and KI.	Iodine representing SO <sub>2</sub> destroyed by Cl.
4.40	100.0	94.7
2.41	100.0	95.4
1.39	100.0	114.4
0.94	100.0	105.4

Experiments were also performed with gaseous chlorine. A known weight of potassium dichromate was treated with hydrochloric acid, in Bunsen's apparatus, and the liberated chlorine led directly into a known slight excess of sulphurous-acid solution, subsequently titrated back by the standard iodine. The iodine solution having been originally standardised from the amount of iodine set free by making the chlorine from a known quantity of dichromate act on potassium iodide, the relative actions of chlorine and iodine were directly calculable. In three experiments, the following numbers were obtained:—

Grms. of chlorine evolved per litre of sulphurous-acid solution employed.	Iodine representing SO <sub>2</sub> destroyed by I (from Cl and KI).	Iodine representing SO <sub>2</sub> destroyed by gaseous Cl.
0.36	100.0	109.8
0.33	100.0	113.0
0.33	100.0	112.8

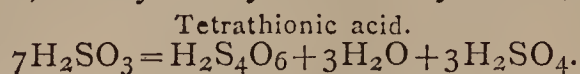
It is clear, from the above-described experiments, that the difference in the action of chlorine and iodine does not depend solely on the strength of the solutions used. Probably temperature and photo-chemical action are also concerned.

Assuming that the action of iodine on sulphurous acid, under the circumstance experimented on, is always represented by the equation  $\text{H}_2\text{SO}_3 + \text{H}_2\text{O} + \text{I}_2 = 2\text{HI} + \text{H}_2\text{SO}_4$ , it is evident that chlorine or bromine *might* cause the destruction of more SO<sub>2</sub> than corresponds to this equation,

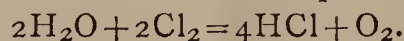
\* Nearly saturated Cl solution, containing, at 0°, 2.2 vols. of Cl gas to 1 vol. of water.



if their actions caused the formation of thionic acids. Thus, for tetrathionate, which, as the preceding experiments show, is only slowly acted on by iodine,



But how it happens that a *less* quantity of  $\text{SO}_2$  is sometimes destroyed by chlorine than by the equivalent amount of iodine is more difficult to explain. Possibly, though this does not seem a very probable supposition, under the influence of light or of other unknown circumstances, free oxygen may be found which escapes without exerting its due influence on the sulphurous acid—



That free oxygen in aqueous solution acts comparatively slowly, at any rate in the dark, on sulphurous acid solution, is shown by the following numbers:—A quantity of saturated sulphurous acid solution was largely diluted with water, saturated with air, and kept in a well-closed opaque vessel. Samples, taken from time to time, indicated that the oxidising action of the dissolved oxygen lasted a considerable time, eighteen hours elapsing before the action became negligible; thus, a given volume (stoppered vessel containing about 300 c.c.) required—

Immediately after mixture..	42.3 c.c. of iodine solution.
10 minutes	40.6 "
20 minutes	40.3 "
1 hour	40.0 "
2 hours	39.9 "
18 hours	39.3 "
40 hours	39.2 "

However, the following experiments indicate that, when the action of chlorine or sulphurous takes place without exposure to daylight, the quantity of acid destroyed is always in excess of that due to the equivalent amount of iodine. The previously-described experiments were performed in the diffused light of a laboratory; but the subsequent ones were all carried out in a cellar only lighted artificially—even the weighings of the chlorine solution being performed there, in order to avoid any possible photo-chemical action.

Weighed bulbs of chlorine solution were broken under known volumes of sulphurous acid, diluted the instant previously with warm or cold water, so as to obtain varying temperatures, and similar determinations were made by breaking chlorine water bulbs under potassium iodide solution at varying temperatures.

From twelve determinations, the following mean numbers were obtained:—

Iodine and Sulphurous acid.		Chlorine and Sulphurous acid.		Rates.
Temperature.	Iodine representing $\text{SO}_2$ destroyed by I.	Temperature.	Iodine representing $\text{SO}_2$ destroyed by Cl.	
14°	104 c.c.	16°	132 c.c.	100 to 127
40°	105 "	35°	186 "	100 to 177

It thus appears that, while variation of temperature makes but little alteration in the action of iodine, it has a great influence on that of chlorine, the difference being the higher the temperature, and always indicates the destruction of more  $\text{SO}_2$  by chlorine than by iodine.

To find if the action of chlorine and iodine becomes identical at 0° with any strength of chlorine solution, bulbs containing chlorine water of varying strengths were broken.

(a). Under known volumes of sulphurous acid solution at the temperature of the cellar (viz., 12° C. throughout this set of determinations).

(b). Under sulphurous acid cooled to 0° by additions of fragments of pure ice (found to have no effect when melted on the iodine solution).

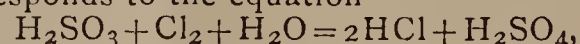
(c). Under potassium iodide at 12° and at 0°: the obtained at these two temperatures never differed by more than 0.1 c.c. from one another (out of 40—50 c.c. used).

The following mean numbers were got from thirty-three determinations:—

Grms. of Chlorine per litre of solution.	Iodine representing $\text{SO}_2$ destroyed by I (from Cl and KI).	Iodine representing $\text{SO}_2$ destroyed by Cl at 12° C.	Iodine representing $\text{SO}_2$ destroyed by Cl at 0° C.
* 7.20	100.0	106.1	103.4
0.68	100.0	102.5	103.9
0.78	100.0	103.3	102.6

It thus appears that at 0° there is little difference between the action of a saturated solution of Cl and one containing only about one-ninth of that amount.

These experiments would tend to show that, when the action of chlorine or sulphurous acid takes place, not under the influence of light, a larger quantity of acid is destroyed than corresponds to the equation—



this extra amount varying with the temperature, and, possibly, with the strength of the solution; whilst, if the action takes place in daylight, the result is so modified, that sometimes more, and sometimes less acid is destroyed than that indicated by this equation. In the case of bromine, also, apparently, there is some irregularity in the action under different circumstances, as is shown by the non-uniform results obtained on repetition of determinations. Iodine, on the other hand, as Bunsen has shown (*Ann. der Chem. und Pharm.*, vol. lxxxvi., p. 265), acts with great regularity and uniformity in accordance with this equation under considerably varied circumstances, unless a solution containing more than 0.4 grms. of  $\text{SO}_2$  per litre be used.

## ON SOME NEW SULPHO-COMPOUNDS.

By S. E. PHILLIPS.

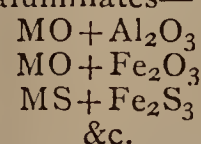
If botanists were to exercise little or no discrimination between natural and aberrant or monstrous forms, we should make but little progress in the very interesting but difficult problem of botanical arrangement and classification. But chemists are perpetually giving us the most puzzling problems; and their accumulation has landed us in a jargon of types and nomenclature utterly bewildering.

It is in this way M. Schneider has just treated us to some new sulpho-saltic types. Hence the following list (see *CHEMICAL NEWS*, vol. xx., p. 264):—

1. Sulphide of silver and iron .. ..	$\text{Ag}_2\text{Fe}_2\text{S}_4$
2. " " iron and sodium .. ..	$\text{Na}_2\text{Fe}_2\text{S}_4$
3. " " bismuth and sodium .. ..	$\text{Na}_2\text{Bi}_2\text{S}_4$
4. " " copper and potassium .. ..	$\text{K}_2\text{Cu}_8\text{S}_6$
5. " " copper and sodium .. ..	$\text{Na}_4\text{Cu}_6\text{S}_6$
6. " " copper, iron, and potassium .. ..	$\text{K}_2\text{FeCu}_3\text{S}_4$
7. " " copper, iron, and sodium .. ..	$\text{Na}_2\text{FeCu}_3\text{S}_4$

We thank him very much for not giving us the rational types of this curious assemblage; whether they are modified types of water or hydrochloric acid, or represent of these arch-types, single, double, or multiple atoms; these are curious points that do not disturb an old chemist. Hence we proceed at once to see how far the old views and intelligible principles may cover the new ground.

The first two would seem to be the most normal form of sulpho-salts for such feeble acid-radicals as copper and iron. The type is a most familiar one, and has a wide range in mineral chemistry. It is that of the corresponding oxy-ferrates and oxy-aluminates—



\* Nearly saturated chlorine water.



No. 3 is a simpler form— $\text{NaO} + \text{BiO}_3$  or  $\text{NaS} + \text{BiS}_3$ .

The others are more complex, or, at any rate, more unusual, if not hybrid and abnormal.

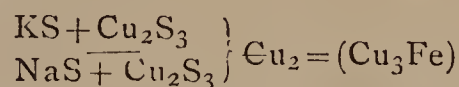
No. 4 is an utter puzzle, and there is probably some mistake in the figures; or is it possible that any of the varied forms of modern type could resolve such an assemblage of elements?

Nos. 5, 6, and 7 may prove varied or hybrid forms of the common sesqui-type above. This hybridity (or by whatever name it should be called) assumes three forms.

First, in No. 5, one S is replaced by one Cu, a most unusual, but perhaps not an impossible, anomaly. As such, it would be  $\text{NaS} + \text{CuS}_2\text{Cu}$ . This may appear to some a large measure of faith in the preservation of a generic type; but, on the other hand, it must be observed that this type is well and widely established, and it is only mooted *pro tem*, until some modern view can supersede it in consistency and simplicity.

Nos. 6 and 7 may be varieties which have two characteristics. The first is a common one, in illustration of which thousands of cases might be cited where Fe replaces Cu, to the preservation of the same type and general properties.

The second one is forced alike upon the attention of old and new chemists, and perhaps has not received that careful attention it so well deserves, though, in some respects, it has been seized hold of and treated as if it were a special part of modern chemical philosophy. I allude to the hypothesis that the ordinary sesqui-sulphide of copper, in these two cases, is a sulphide where two ordinary atoms have a double condensation, and act and re-act as one element. The type of these two bodies would be thus—



As modern chemists have perhaps unwisely abandoned the method of indicating the doubled atoms by a cross-line (thereby occasioning great trouble and perplexity to some who either do not or will not understand the new arrangements), I have here adopted it with a new signification. It bespeaks a molecule of double condensation, but which is not a duad in the modern acceptance—viz., it does not represent the equivalence of  $2\text{H}$ , &c.

The underlining is a convenient way of referring any common type to a marginal explanation.

The entire philosophy of allotropic or isomeric variation will not be fully embraced by any one feature, but this one has powerfully struck the writer in the course of study for many years past. It seems to take place with both elements and compounds; and one of the earliest instances probably on record, is that of  $(\text{CO}) = 14$  (the radical of carbonic acid) and  $(\text{CO}) = 28$  (the radical of oxalic acid), both of which represent 1 atom of H or other equivalent in a variety of substitutional type modifications. We have  $\text{HH}_2\text{N}$  (ammonia); and, by a generic reaction, carbonic acid gives  $(\text{CO})\text{H}_2\text{N}$  (carbamide); and, similarly, oxalic acid gives  $(\text{CO})\text{H}_2\text{N}$  (oxamide), &c., all normal 2-vol. compounds. And these, by a further extension of the same reaction, give carbamic and oxamic acids, &c.

The ammonia and atmonia type affords a striking illustration: it is as if ammonia,  $(\text{H}_3\text{N}) = 17$ , by an allotropic or double condensation, gave atmonia,  $(\text{H}_3\text{N}) = 34$ ; both interchangeably representing one constituent and one vol. in a wide series of combinations.

The precise case here given is, as yet, hypothetical; but the facts are wide and well-known in great extensions.

Ammonia, $\text{HH}_2\text{N}$	.. ..	Oxide of ammonium, $\text{HH}_3\text{N}_2\text{O}$
Ethylia, $\text{EH}_2\text{N}$	.. ..	.. .. ethylium, $\text{EH}_3\text{N}_2\text{O}$
UREA, $(\text{CO})_2\text{H}_4\text{N}_2$	.. ..	.. .. urea, $(\text{CO})_2\text{H}_5\text{N}_2\text{O}$
		&c.

Whatever the future may unfold in regard to this isomeric condensation, one thing at least is certain—that copper was one of the first elements to force it upon the attention of chemists.

As we have  $\text{MnO}_3$  and  $\text{Mn}_2\text{O}_7$ ,

So we have  $\text{NH}_3$  and  $\text{N}_2\text{H}_7$ ;

Such being an old and familiar transitional arrangement within prescribed limits of mineral chemistry, the first being a ratio of one to three, the second that of one to three-and-a-half.

If old mineral chemistry has lighted up the path into the profounder depths of organic chemistry, truly may we say she is likely to be repaid with a mighty interest of reflex light and illumination.

It only remains to compare the percentage composition of the old and new types—

		NEW.				OLD.			
1. Sulphide of silver and iron	.. ..	$\text{Ag}_2$	..	47.38	.. ..	47.38	..	$\text{Ag}$	} = $\text{AgS} + \text{Fe}_2\text{S}_3$
		$\text{Fe}_2$	..	24.56	.. ..	24.56	..	$\text{Fe}_2$	
		$\text{S}_4$	..	28.06	.. ..	28.07	..	$\text{S}_4$	
2. " iron and sodium	.. ..	$\text{Na}_2$	..	12.43	.. ..	12.80	..	$\text{Na}$	} = $\text{NaS} + \text{Fe}_2\text{S}_3 \text{ HO}$
		$\text{Fe}_2$	..	31.07	.. ..	31.28	..	$\text{Fe}_2$	
		$\text{S}_4$	..	35.44	.. ..	35.75	..	$\text{S}_4$	
		$\text{HO}$	..	19.58	.. ..	20.17	..	$\text{HO}$	
3. " bismuth and sodium	.. ..	$\text{N}_2$	..	7.79	.. ..	7.79	..	$\text{Na}$	} = $\text{NaS} + \text{BiS}_3$
		$\text{Bi}_2$	..	70.51	.. ..	70.51	..	$\text{Bi}$	
		$\text{S}_4$	..	21.70	.. ..	21.70	..	$\text{S}_4$	
4. " copper and potassium	..	$\text{K}_2$	..	10.05	} .. ..	(?)	..	(?)	(?)
		$\text{Cu}_8$	..	65.27			..		
		$\text{S}_6$	..	24.68			..		
5. " copper and sodium	.. ..	$\text{Na}_4$	..	13.84	.. ..	13.86	..	$\text{Na}$	} = $\text{NaS} + \text{Cu}_2\text{S}_2\text{Cu}$
		$\text{Cu}_6$	..	57.29	.. ..	57.11	..	$\text{Cu}_2$	
		$\text{S}_6$	..	28.87	.. ..	29.03	..	$\text{S}_3$	
6. " copper, iron, and potassium		$\text{K}_2$	..	17.28	.. ..	10.994	..	$\text{K}$	} = $\text{KS} + \text{Cu}_2\text{S}_3$
		$\text{Fe}$	..	12.38	.. ..	13.348	..	$\text{Fe}$	
		$\text{Cu}_3$	..	40.08	.. ..	45.108	..	$\text{Cu}_3$	
		$\text{S}_4$	..	28.27	.. ..	30.550	..	$\text{S}_3$	
7. " copper, iron, and sodium	..	$\text{Na}_2$	..	10.94	.. ..	13.457	..	$\text{Na}$	} = $\text{NaS} + \text{Cu}_2\text{S}_3$
		$\text{Fe}$	..	13.32	.. ..	12.993	..	$\text{Fe}$	
		$\text{Cu}_3$	..	43.50	.. ..	43.871	..	$\text{Cu}_3$	
		$\text{S}_4$	..	30.44	.. ..	29.698	..	$\text{S}_3$	

$\left. \begin{array}{l} \text{Cu}_2\text{Fe} \\ \text{Cu}_3\text{Fe} \end{array} \right\} \text{Cu}_2 = \text{Cu}_3\text{Fe}$



As to the nomenclature, nothing could be plainer: they are sulpho-ferrates, sulpho-cuprates, or sulpho-bismuthates of sodium, &c., corresponding with the oxy-ferrates, cuprates, or bismuthates, where we have agreed, in deference to common usage, that the oxy-prefix shall be understood, though unexpressed.

And, just as a sulphate or ferrate means oxy-ferrate of an oxide, so sulpho-ferrate or chloro-ferrate means sulpho-ferrate of a sulphide or chloro-ferrate of a chloride, the latter prefix being implied in the former.

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ON A

## NEW METHOD OF SEPARATING TIN FROM ARSENIC, ANTIMONY, AND MOLYBDENUM.

By FRANK WIGGLESWORTH CLARKE, S.B.

SOME time since, happening to notice that the remarkable highly-crystalline precipitate formed by oxalic acid in a solution of stannous chloride was not blackened or otherwise affected by sulphuretted hydrogen, I was led to a series of experiments concerning the action of the above-named acid upon certain metallic sulphides, and obtained the following results.

Both sulphides of tin, if moist and freshly precipitated, are readily decomposed by moderately-long boiling with an excess of oxalic acid,  $H_2S$  being given off. The monosulphide is converted into the insoluble, crystalline stannous oxalate; while the yellow disulphide is completely dissolved. The commercial "Mosaic gold," however, seems to be unacted upon by the reagent. In presence of an excess of oxalic acid, tin cannot be precipitated by  $H_2S$ .

The sulphides of arsenic, even upon very long boiling with the acid, are almost unattacked. Very minute traces of the metal sometimes go into solution, but may be re-precipitated by a bubble or two of  $H_2S$ . Accordingly, the presence even of an enormous excess of oxalic acid does not hinder the precipitation of arsenic as sulphide.

The sulphide of antimony behaves in a somewhat different manner. Although, upon long boiling with oxalic acid, considerable quantities of the metal are taken into solution, yet every trace of it may be re-precipitated by  $H_2S$ .

Molybdic trisulphide appears to be wholly unattacked by oxalic acid, even upon very long boiling.

With the sulphides of tungsten I have obtained discordant results. Under certain circumstances, they seem to be wholly insoluble in the acid; while, at other times, they are decomposed completely, and partly taken into solution.

By availing myself of the solubility of the sulphides of tin in oxalic acid, I have been enabled to separate tin perfectly from arsenic and molybdenum, and almost perfectly from antimony. When only arsenic and antimony are to be separated from tin, I find it best to proceed as follows:—To the solution containing the three metals (this solution being prepared in the usual manner for the precipitation of the sulphides) I add oxalic acid, in the proportion of about 20 grms. of the reagent for every gramme of tin, taking care to have the whole so concentrated that the acid will crystallise out in the cold. I then heat to boiling, and pass in sulphuretted hydrogen for about twenty minutes. No precipitate appears at first; but, as soon as the liquid is saturated with the gas, the sulphides of arsenic and antimony begin to fall, and, in a very few moments, are completely thrown down. Then, as usual, the whole should be allowed to stand about half-an-hour in a warm place, before filtering. Every trace of arsenic and antimony is precipitated, so that, in the filtrate from the sulphides, neither of these metals can be discovered by Marsh's test, nor can any antimony-stain be produced with zinc upon platinum. I have

carefully experimented to learn whether oxalic acid could interfere with either of these tests, and find that it has not the slightest influence upon them. The sulphide of arsenic is absolutely free from tin; but the antimony always carries down a minute trace of that metal with it: this trace, however, if the operation has been carefully performed, can scarcely be detected, and generally may be ignored with safety. If, however, the greatest accuracy is desired, it may be well to re-dissolve the sulphide of antimony in an alkaline sulphide, decompose the solution with an excess of oxalic acid, boil with a little strong sulphydric-acid water, filter, and add the filtrate to the tin solution previously obtained.

To separate tin from molybdenum, owing to the difficulty of precipitating the latter metal with  $H_2S$ , I have been obliged to slightly vary my process. I find that, by adding an alkaline sulphide in excess to a solution containing molybdate, then decomposing the sulphur-salt formed with a considerable quantity of dilute chlorhydric acid, and allowing the whole to stand over night in a warm place, every trace of molybdenum is precipitated. The sulphide thus obtained can be easily washed with a mixture of dilute chlorhydric acid and ammoniac chloride. If, now, by this process we throw down tin and molybdenum together, every trace of the former metal may be dissolved out by boiling the mixed sulphides for about three-quarters-of-an-hour with oxalic acid, in the proportions which I have already given. It is best to have present in the solution, while boiling, a little dilute chlorhydric acid.

If antimony, also, is contained in the mixture, it is necessary, just before ceasing to boil, to add to the solution an equal volume of strong sulphydric-acid water, to re-precipitate any of that metal which may have gone into solution. Upon filtering, no molybdenum can be detected in the filtrate by any ordinary tests, and the molybdic sulphide is absolutely free from tin. In all these cases, it is assumed that the tin is in the form of a stannic compound. It must be borne in mind that the lower sulphide of this metal is converted by the acid into an oxalate insoluble in water; but, as the latter dissolves to an almost unlimited extent in dilute  $HCl$ , its formation need not interfere with an analysis.

Since the presence of oxalic acid interferes somewhat with the complete precipitation of tin by ordinary methods, I was subjected to some trouble in finding a process for determining that metal after the separation. At last I found it could be thrown down as follows:—The solution, after being rendered slightly alkaline with ammonia, is mixed with enough ammoniac sulphide to re-dissolve the precipitate at first formed; an excess of acetic acid is added, and the whole allowed to rest several hours in a warm place. Acetic acid must be used, for stronger acids would be liable to set free some of the oxalic to re-dissolve the tin. The precipitate, which at first varies from white to pale yellow, rapidly darkens in colour, and seemingly consists of a mixture of oxide and sulphide of tin. It should be washed with a solution of ammoniac nitrate, and, after ignition, is weighed as  $SnO_2$ . In two successive experiments, in which I mixed a weighed quantity of tin with unknown proportions of arsenic and antimony, I received of the tin, after making my separation, respectively 99.93 and 99.57 per cent. The loss in the second case was due to my not having allowed the tin-precipitate to settle sufficiently long before filtering—in other words, to incomplete precipitation.

The arsenic and antimony, being in the form of sulphides, may be estimated by any of the ordinary methods. They may be best separated by Bunsen's process with sulphurous acid, which, though far from perfect, is superior to all others. Lensen's method, in which the arsenic is precipitated from the sulphur solution of the two metals as ammonia-magnesian arsenate, is worthless.

A couple of years ago, I made a few experiments upon indirectly determining the proportions of tin and antimony in alloys of the two metals. I oxidised a weighed



quantity of the alloy with nitric acid in a porcelain crucible, heated the resulting oxides with ammonic nitrate, and then (regarding the tin as converted into  $\text{SnO}_2$ , and the antimony into  $\text{Sb}_2\text{O}_3$ ) calculated the proportions of the metals from the increase in weight. This method, although by no means giving me accurate results, served very well for rough approximate determinations. I cite it here simply as an easy and convenient process for obtaining a close idea of the constitution of any alloy composed of the two metals. Possibly the method might be so modified as to give accurate determinations.—*American Journal of Science*, Jan., 1870.

## ON MICROSCOPICAL MANIPULATION.

By W. T. SUFFOLK, F.R.M.S.

(Continued from p. 114).

### LESSON III.

*Specimens Required*—Flour, Starch (Arrow-root, Potato-starch, or Brown and Polson's Corn Flour),\* Chalk (in Lump, not Whiting or Washed Chalk), Powdered Lump-Sugar, and Common Table-Salt.

EXAMINE by placing a minute quantity of each of these white powders on the stage-plate, and examine with  $\text{O}_1$ , by reflected light, as in preceding lessons. Notice the different appearances of each. The flour will be found to contain numerous rounded, glittering bodies (starch granules), mixed up with a quantity of matter not easily defined with the power employed. The starch consists entirely of these shining substances, which, in the larger kinds, as "*Tous-les-mois*," cause a distinct glittering appearance without any optical aid, if examined in a good light. The chalk is apparently structureless. The sugar and salt exhibit numerous crystals, more or less broken.

The student will do well to examine the solubility of these substances, by shaking a little of each in a test-tube, with water. Small portions should also be heated to redness, on a slip of platinum foil, in the flame of a spirit-lamp. The flour and starch will be carbonised and burnt to an ash, if the heat is long continued. The chalk will still remain white. The sugar will melt, and then carbonise. The salt will decrepitate or crackle, and bound off the platinum.

These simple chemical examinations should not be neglected by the microscopist, especially when examining unknown substances. Some skill in the use of the blowpipe may occasionally be of service. Solubility of a substance in water or other fluids may be tested under the microscope, and with the advantage that very small quantities are sufficient for experiment. Other reagents may also be employed. "Beale," p. 201.

*Flour and Starch*.—Place a little of the starch and flour on separate slides, with a drop of water; stir up with the point of a knife or needle, to diffuse the particles; cover with thin glass, and view with same power, first with dark-field illumination, and afterwards by transmitted light. Then use  $\text{O}_4\text{M}$  by transmitted light. The flour will be seen to consist of the before-mentioned rounded bodies, with a small admixture of fragments of membrane, cell, wall, &c. These

\* This is a very cleanly prepared *maize*-starch, which may be used for nearly every purpose where arrow-root is required. It would be well if manufacturers would call things by their right names. The term "flour" is likely to mislead; it means something quite different. Corn-starch or maize-starch would be more suitable.

are best seen in meal made by crushing or grating a grain of corn, as flour in general is too finely sifted to contain much of these textures. The slide of starch will exhibit the same rounded bodies, starch granules. They are best studied in a large-grained kind, such as *Tous-les-mois*,\* the product of *Canna edulis*. With  $\text{O}_4\text{M}$  and transmitted light, a number of concentric rings will be seen, surrounding a spot known as the *hilum*. Microscopists differ respecting the nature of these markings (see article, *Starch*, "Micrographic Dictionary," p. 657; "Carpenter," p. 399). Examine with *polariscope*  $\text{O}_1$ , and, if possible, with higher powers. Notice the characteristic black cross, having its centre at the hilum. In oat-starch the black cross is wanting, the grains are polygonal, and clustered in rounded masses. Test the contents of the slides with a solution of iodine in water, made by placing a small crystal in distilled water. When it has acquired a straw colour, it will be of sufficient strength; only a minute quantity will be dissolved. A small drop of this reagent is to be placed at the edge of the cover with a pointed pipette, or, better, with one of the test-bottles with perforated conical stoppers. When the iodine reaches the starch granules, they will be stained of a violet colour. This and the polarisation test will readily distinguish starch granules from other round bodies. A series of starches from various plants should be mounted, and kept for comparison. Two slides of each should be prepared, one dry, the other in balsam, for examination with the polariscope. When starch is mounted in balsam, care should be taken to employ as little heat as possible. Starch granules are not well preserved in fluids. Starch may be separated from flour by making it into a stiff paste, tying it in a muslin bag, and kneading in water. The gluten will be left in the bag, and the starch will fall to the bottom of the vessel, and can be cleaned by washing and decantation of the supernatant fluid. Roots, &c. (as potatoes and carrots), can be crushed or grated, and the starch washed out, cleaned, and collected. Starch may be viewed *in situ* by cutting thin sections of potato. These may be dried by the ether process (vol. xix., p. 194), and some mounted dry, and others transferred to benzol, and then mounted in balsam.

Starches from various sources, and the structure of wheat, barley, and other kinds of grain, are accurately figured in "Hassall," pp. 242—256 and 314—321.

The student should make accurate outline-sketches of all the starches examined, with the camera-lucida or tinted reflector, selecting, in each specimen, the largest and smallest granules, and also some of intermediate size. A scale should be drawn on the paper from the micrometer. The shape and dimensions of starch granules and other similar objects are readily compared from such drawings, and with far greater facility than from lists of micrometric figures.

*Chalk*.—Scrape a small portion of the chalk upon a slide. Place upon it a drop of water, stir it up, allow the larger particles to subside, and then gently tilt the slide, so that the water may run down, and carry with it the lighter particles. Absorb the surplus wet with blotting-paper, dry cautiously over the lamp-chimney, and mount in balsam.

+ *Tous-les-mois* can be obtained of Messrs. Fortnum and Mason; also genuine arrow-root and other materials, which can be depended upon for use as standard samples.



Examine with  $O\frac{1}{2}$ , or [ $O1$ ,  $E2$  or  $3$ ] black-field illumination, with PARABOLA or [*spotted-lens*]. If the preparation has been successful, *Foraminifera* may be distinguished among some of the particles. It is well to make two or three preparations, in case of failure.

To obtain the shells, sponge-spicules, &c., separately, it will be necessary to break up the chalk. This is best effected by boiling in a solution of sulphate of soda, made strong enough to crystallise on cooling: on this taking place, the chalk will be found to be disintegrated (Quekett's "Lectures on Histology," vol. ii., p. 80). Sufficient water should then be added to dissolve the crystals, the mixture agitated, and the chalk allowed to settle. The fluid should be decanted, the vessel again filled up with water, and decantation repeated before the finer particles have subsided. By continuing this process, if carefully managed, the shells will be obtained, eventually, nearly or quite clean. The washings should be allowed to settle, and be examined with the microscope, to ascertain whether they contain any of the smaller fossils. The shells may be mounted dry or in balsam. The result will vary according to the locality from which the chalk was obtained.

Another very efficient process, by Mr. E. H. Robertson, will be found in *Science Gossip*, vol. iii., p. 36.

If the sponge-spicules and siliceous fossils only are required, they can be obtained by dissolving the chalk in dilute hydrochloric acid.

The coarse matter left after chalk has been washed for the purpose of making whiting is, when it can be procured, a good material to operate upon, as it is much richer in minute fossils, which are left in the heavier portions of the chalk.

The *Polycystinae* may be obtained from the "Barbadoes-earth," by a process fully described by S. Furlong, *Quarterly Microscopical Journal*, Jan., 1861; also quoted by Davies, in "Mounting Microscopic Objects," p. 64.

*Sugar and Salt*.—The preliminary examination has already shown that these two substances differ materially in appearance from the others with which they were compared. While they exhibited none of the organised structure of the flour and starch, yet the difference between them and the chalk was very marked. They presented, when not too much crushed, traces of a certain regularity of form, which was entirely absent in the latter mineral. The condition of both the sugar and salt was very unfavourable for the study of these regular forms, which are known as crystalline. For further examination, it will be necessary to procure uninjured specimens.

Well-formed crystals may generally be found in most samples of good moist-sugar: a few of these are to be mounted in balsam, for examination. Sugar is rather difficult to crystallise in the small way, the general result being an amorphous film on the slide. For a very full account of sugar, see "Hassall," pp. 181—198.

Crystals of salt are easily obtained. Make a strong solution in distilled water, by boiling in a test-tube, and filter while hot. A drop of this fluid, placed upon a slide, will soon deposit a number of cubic crystals. These and the sugar-crystals may be viewed with a low power,  $O2$ , and dark-field illumination, by means of the PARABOLIC REFLECTOR or [*spotted lens*]. This mode of lighting is very

useful in such examinations, as it aids considerably in estimating solidity. Beyond regular mathematical form, no structure is to be observed in these bodies. *Polarised light*, however, renders certain optical peculiarities apparent.

Arrange the microscope for the use of the polariscope: it will then be seen that the crystals of salt are not at all affected by the altered illumination, and this is the case with all crystals belonging to the cubic system: crystals of potash-alum will supply another example. Let the sugar now be examined in the same way: it will be found, upon rotating the analyser or polariser, that they either become coloured or, when the field is darkened, remain luminous. If the thickness of the crystals is not adapted to produce colour, the use of a suitable selenite film will assist in obtaining it. It is here evident that polarised light reveals something which we should not be aware of without its aid: it supplies the means of determining whether a crystal possesses the property of double refraction or not.

The forms and colours of many crystals are extremely beautiful, and a collection is very easily made. As a long list will be found in "Carpenter," p. 773, only a few salts will be mentioned here.

Make a hot saturated solution of sulphate of copper. If a drop of this warm solution is placed upon a slip of glass, and examined at once,\* long crystals, with sloping ends like a turner's chisel, will be seen shooting out from the edge, which will eventually cover the centre. If a small quantity of nitrous ether be added to the solution, a number of the crystals will be obtained in the form of separate rhomboids, which will shine like richly-coloured gems on the black field of the polarising microscope. Both slides, when dry, should be mounted in balsam, and labelled.

Some curious phenomena attending the crystallisation of sulphate of copper are described by Mr. R. Thomas in the *Quarterly Microscopical Journal* (1866, p. 177). An abstract of the paper, with figures, will be found in "Beale," p. 214.

The crystals of salicine are very easily made, and are very good examples of radiating crystals. A saturated solution in distilled water is to be made, and a drop, placed on a carefully-cleaned slide, is to be evaporated over the lamp until it dries into an amorphous mass. Upon cooling, a number of circular groups of crystals will generally be formed; this may be aided by breathing on the slide, the moisture often inducing the formation of the crystals. When sufficiently developed, the process should be stopped, by gently heating over the lamp-chimney, and mounting at once in balsam.

An account of the mode of making the beautiful flower-like crystals of sulphate of copper and magnesia is given in "Mounting Microscopic Objects," by T. Davies, p. 76.

(To be continued.)

**Manufacture of White-Lead.**—An invention is at present being tested by which ordinary galena, after having been crushed in an ore crusher, is roasted in a desulphurising kiln, and next mixed with carbon (preferably in the state of fine-washed pea or dust anthracite coal) in the proportion of half and half. This mixture is heated in a peculiarly-constructed furnace; and the dense white vapours which are given off are conveyed into a separate chamber, and strained, by passing through bags or screens of muslin, or are allowed to deposit slowly, and, after cooling, collected, as in the case of the manufacture of zinc-white.

\* For this purpose, the microscope must be placed vertically, to prevent the fluid running off the slide, as the observation is best made without a cover. The instrument should only be used in this position when absolutely necessary, as it is uncomfortable and inconvenient.



MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

(Concluded from p. 117.)

Ordinary Meeting, February 22, 1870.

J. P. JOULE, D.C.L., LL.D., F.R.S., &c., President in the Chair.

"On the Organic Matter of Human Breath in Health and Disease," by Dr. ARTHUR RANSOME, M.A.

The vapour of the breath was condensed in a large glass flask surrounded by ice and salt, by which a temperature several degrees below zero was obtained. The fluid collected was then analysed for free ammonia, urea and kindred substances; and for organic ammonia—the method employed being that invented by Messrs. Wanklyn and Chapman for water analysis.

The breath of eleven healthy persons and of 17 affected by different disorders was thus examined, and the results were given in two tables.

The persons examined were of different sexes and ages, and the time of the day at which the breath was condensed varied.

In both health and disease the free ammonia varied considerably, and the variation could not be connected with the time of the day, the fasting or full condition. Urea was sought for in fifteen instances—three healthy persons and twelve cases of disease—but it was only found in two cases of kidney disease, in one case of diphtheria, and a faint indication of its presence occurred in a female suffering from catarrh.

The quantity of ammonia, arising from the destruction of organic matter, also varied, possibly from the oxidation of albuminous particles by the process of respiration; but in healthy persons there was a remarkable uniformity in the total quantity of ammonia obtained by the process. Amongst adults the maximum quantity per 100 minims of fluid was 0.45 of a milligramme, and the minimum was 0.35.

A rough calculation was given of the total quantity of organic matter passing from the lungs in twenty-four hours—in adults about 3 grs. in 10 ozs. of aqueous vapour, a quantity small in itself, but sufficient to make this fluid highly decomposable, and ready to foster the growth of the germs of disease.

In disease there was much greater variation in the amount and kind of organic matter given off.

In three cases of catarrh, one of measles, and one of diphtheria, the total ammonia obtained was much less than in health—less than 0.2 of a milligramme—a result probably due to the abundance of mucus in those complaints, by which the fine solid particles of the breath were entangled.

In two cases of whooping cough it was also deficient, but as they were both children, the lack of organic matter may have been due to their age.

In cases of consumption, also, the total ammonia was less than in health; but in one case of this disease associated with Bright's disease a large amount of organic matter was given off, a portion of it due to urea.

In kidney diseases the largest amount of organic matter of all kinds was found in the breath. The ammonia in one case of Bright's disease was 1.8 milligrammes in 100 minims of fluid, and urea was largely present. Perhaps this fact might be taken as an indication of the need of measures directed to increase the activity of other excretory organs.

In one case of ozona or offensive breath the total quantity of ammonia obtained was greater than in any healthy subject, but the excess was chiefly due to organic matter.

One convalescent case of fever was examined, and the total ammonia was found to be deficient.

The air of a crowded railway carriage, after fifteen minutes occupation, was also tested by this method and

in about 2 cubic feet 0.3 milligrammes of ammonia and 3 milligrammes of organic matter were found.

With reference to the presence of organic matter in the atmosphere, it was pointed out that the subject was in no way a novel one, and that it had, during the last thirty years, been very fully investigated by many observers, more especially by Schwann, Dusch, Schroeder, Helmholtz, Van den Broeck, Pasteur and Pouchet, but it was shown that it is to Dr. Angus Smith that we owe the discovery of the readiness with which living organisms are formed in the condensed breath of crowded meetings, and the determination of the actual quantity of organic matter in the air of different localities.

Mr. Dancer's calculation of the number of spores contained in the air was noticed, but a source of error was pointed out in the readiness with which organisms are developed in suitable fluids, even in the course of a few hours. Observations upon the organic particles of respired air had at different times been made by the author.

1. In 1857, glass plates covered with glycerine had been exposed in different places and examined microscopically. Amongst others, in the dome of the Borough Gaol, to which all the respired air in the building is conducted, organised particles from the lungs and various fibres were found in this air.

2. During a crowded meeting at the Free Trade Hall air from one of the boxes was drawn for two hours through distilled water, and the sediment examined after thirty-six hours. The following objects were noted:—Fibres, separate cellules, nucleated cells surrounded by granular matter, numerous epithelial scales from the lungs and skin.

3. The dust from the top of one of the pillars was also examined, and in addition to other objects, the same epithelial scales were detected.

4. Several of the specimens of fluid from the lungs were also searched with the microscope. In all of them epithetium in different stages of deterioration was abundantly present, but very few spores were found in any fresh specimen. On the other hand, after the fluid had been kept for a few hours, myriads of vibriones and many spores were found.

In a case of diphtheria, confervoid filaments were noticed, and in two other cases, one of measles and one of whooping cough, abundant specimens of a small-celled torula were found, and these were seen to increase in numbers for two days, after which they ceased to develope.

These differences in the nature of the bodies met with probably show some difference in the nature of the fluid given off; but it was pointed out that they afford no proof as yet of the germ theory of disease. They simply show the readiness with which aqueous vapour of the breath supports fermentation, and the dangers of bad ventilation, especially in hospitals.

Dr. E. LUND and Dr. H. BROWNE stated that they had also made experiments, the results of which were, in general, confirmatory of those obtained by Dr. Ransome.

QUEKETT MICROSCOPICAL CLUB.

THE annual *conversazione* of this club took place at University College on Friday evening, and was attended by a very numerous assembly of members and visitors.

The objects exhibited under the microscopes comprised specimens from nearly every branch of microscopical science, and evinced by their novelty an evident desire on the part of the members to cultivate every source likely to yield instruction. Amidst so much to attract attention it is impossible to make a selection; we may, therefore, merely remark that amateurs and professionals were equally assiduous in contributing to the general entertainment of the company. In addition to the objects exhibited, an interesting collection of photographs lent by the India



Office, the Autotype Company, Mr. Frank, Mr. Good, and Mr. A. L. Henderson were much admired.

The whole process of micro-photography was demonstrated at frequent intervals by the Messrs. Solomon, the actinic influence being derived from their new magnesium lamp. Mr. Apps exhibited some large Gassiot's cascades and Geissler's tubes illuminated by his celebrated induction coil, and Mr. James How displayed Dr. Maddox's micro-photographs and some views of Swiss scenery, &c., by the aid of the oxy-hydrogen light. The meeting may be described as eminently successful.

## NOTICES OF BOOKS.

*First Lessons in Inorganic Chemistry.* By T. WARD, F.C.S., &c. Manchester: John Heywood. London: Simpkin, Marshall, and Co. 286 pages.

THERE is already more than a superabundance of small text-books and manuals on chemistry; and it is a matter for wonder that, while there is no lack of really excellent books for young pupils, so many authors rush into print, imagining that they can improve upon what exists, and evidently forgetting "*Comment fait on des livres? Avec des livres.*" Let us briefly glance at the contents of this little volume. It partakes, in its arrangement, of two excellent works—viz., Stöckhardt's well-known book, and the small volume written by Professor Roscoe. We are sorry to be compelled to say that Mr. Ward's book is inferior to each of these, individually, as it is deficient in that lucid and precise clearness of exposition and soundness of definition which so eminently characterises the two works just alluded to. While we thus express our opinion, we must in all fairness also say that, as far as we have perused Mr. Ward's book, we have not found therein any heterodox or incorrect statements. The book is well got up, is provided with woodcuts, and contains some very useful tables relating to weights and measures, thermometer degrees, and a copious index. There is also added a chapter on qualitative analysis, which is, however, too brief to be of much use.

*An Introduction to the Study of Chymistry, written for the People.* By CUTHBERT C. GRUNDY. London: Simpkin, Marshall, and Co. 1870. 108 pages.

OUR first remark applies to the use and spelling of the word *chymistry*. Although the origin, or primitive meaning of this word is not satisfactorily explained, there is little doubt about the proper spelling, omitting even for the moment so old an origin as that which is sometimes assigned to chemistry as the Egyptian art, or as the secret art of transmutation, as practised by the Chémi (the Koptic for Egyptians). It is undeniable that Zosimus, in the fifth century of our era wrote *χημεία*, derived from *χέω*, or *χέωω* (to melt, or to fuse); but there certainly is no warrant for using the *y*, since neither the Greek substantive nor the verb contains the *v* placed as this author would have it. As to the contents of the book, while admitting that there is in it a large amount of useful information, it is equally true that it is, in many respects, a curious *olla podrida*; and this especially applies to the attempt evidently made of compressing a great deal into a very confined space. On page 20, we read—"There are two kinds or classes of matter. Matter which has been formed by the action of animals or of plants, or which is part of an animal or of a plant, is called organic matter; because it is a part of the substance of the organs of the animal or of the plant, or is produced by these organs. Wood is an organic substance, because it is a part of the plant; starch is organic matter, because it is formed by the organs of the plant; flesh is organic matter, because it is part of the animal." It would seem that the author

has no idea of the distinction to be made between *organised* and *organic* substances or matter. The book is by no means free from incorrect statements—e.g., page 83 we read—"For chlorine cannot bleach mineral colours." How, then, does it act upon ultramarine, or upon Scheele's green? Of phosphorus, we read that it can be obtained in the free state only by artificial means; this is, of course, quite correct, but this equally applies to silicon, of which it is said it is not found in free state, while, according to the author, boron is not known in free state—a statement which is quite incorrect, for it may be obtained in the free state by artificial means just as well as phosphorus and silicon.

The appendix is the best, and, in many respects, most valuable part of the book, since in it are given the rules applying to decimal fractions, the decimal system of weights and measures, and the value thereof according to the English system. The author has, we fear, written rather hurriedly; and, by trying to compress too much information in a small space, sacrificed that clearness which should characterise a book of this nature intended for the great body of the people.

## CORRESPONDENCE.

### QUANTIVALENCE OF SODIUM, &c.

*To the Editor of the Chemical News.*

SIR,—From the letters of Mr. G. E. Davis, and Mr. Noel Hartley, which have recently appeared in the CHEMICAL NEWS, it would seem that these gentlemen consider that there is something quite new in regarding sodium, potassium, &c., as capable of acting as triads and pentads. Now, I respectfully submit that there is no great novelty in the matter; such views having been put forth by several chemists at various times, but, without going further into the subject, I will simply call attention to a paper which I wrote on this question (CHEMICAL NEWS, vol. xvi., p. 43, July 26, 1867), with the object of showing "that reputed monads may, under certain circumstances, play the part of triads and pentads. Indeed, anyone who considers such compounds as that of potassium with hydrogen and fluorine,  $\text{KHF}_2$ , and that of silver with hydrogen and iodine,  $\text{AgHI}_2$ , can hardly fail to regard one at least of the elements so combined as acting, for the time being, the part of a triad. Professor Wanklyn, however, is not content with regarding sodium as occasionally capable of triadic functions; he seems to argue that it is never a monad, and this extreme view appears to be quite untenable in the present state of science.

One word, in conclusion, with reference to the two classes into which Dr. Williamson has divided the elements, viz., those of even and uneven quantivalence, or, as Dr. Odling calls them, artiads and perissads; I believe that there is no hard and fast line between these two classes, and could produce evidence on this point, but will, at present, merely remark that quantivalence must be regarded as a state or condition of matter, and not as an unalterable property attached to this or that element.—I am, &c.,

JOHN A. R. NEWLANDS, F.C.S.

13, Knowle Road, Brixton, S.W.  
February 28, 1870.

### TREATING EXCRETA OF TOWNS.

*To the Editor of the Chemical News.*

SIR,—I have just been shown an article in the CHEMICAL NEWS of October 22nd, 1869 (vol. xx., p. 196), on "A Chemical Method of Treating the Excreta of Towns," by Edward C. C. Stanford, F.C.S. It may be interesting



to your readers to have a short description of the system of conservancy I have persistently been trying to introduce into India for the last eighteen months. I must premise that, in tropical climates, the evils of the water sewage are greatly increased. The water with which the sewers are flushed is hot; putrefactive fermentation takes place very rapidly, as, also, does fungoid vegetation. The system I propose is to carbonise the filth in retorts, and to utilise the gas for heating the furnace and for illuminating. The filth is thoroughly deodorised, by means of the poudrette coke (the residue left in the retorts), and can be carried in carts or open vessels to the carbonising apparatus. In order to obtain an extra quantity of gas for heating the furnace, I purpose either making the retorts reciprocating, or using double retorts, with mouth-pieces, lids, and ascension-pipes at both ends; by this means, the charge of one retort, or of half a double retort, can be so arranged that the steam first given off will pass through and over the incandescent poudrette coke lying in the other half, or in the reciprocating retort, as the case may be. By this means, the steam becomes decomposed and forms two gases, hydrogen and carbonic oxide. There must be stop-valves in the ascension-pipes to carry out this arrangement. I have always insisted that the poudrette coke, surcharged with ordure, will give a highly-luminous gas. I am now preparing a project for the conservancy of the Cantonment of Dum-Dum, by order of the Viceroy in Council, and will send you full particulars of the result.

It may be thought that if the carbon be used to make carbonic oxide by decomposing the water, it will not be available as poudrette coke for deodorising fresh filth; but one, or a pair of retorts, loaded and so used, out of a group of five, will give sufficient gas for heating the furnace. For Dum-Dum, I propose having a group of five retorts (double), with a furnace-grate for coke at one end and a pipe passing in for gas at the other end through the back wall. There is a condenser, with a tank for collecting the tar and ammoniacal liquor; a dry-lime purifier, for getting rid of any carbonic acid; and a small gas-holder, for regulating the supply of gas to the furnace.—I am, &c.,

W. R. GILBERT HICKEY, C.E.

Calcutta, Feb. 1st, 1870.

## MISCELLANEOUS.

**Death of Dr. Redtenbacher.**—We regret to have to announce the death of Joseph Redtenbacher, M.D., &c., Professor of Chemistry at the University of Vienna. The deceased was born on March 12th, 1810, at Kirchdorff (Austria), and held, since 1849, the Chair of Chemistry just alluded to. He was well known as the author of a large number of scientific memoirs and papers, and was a member of the Imperial and Royal Academy of Vienna from the date of its foundation, some forty years ago.

**New Dictionary of Science.**—Messrs. Moxon and Co. are preparing for publication a Dictionary of Science, edited by Mr. G. Farrer Rodwell. It will be uniform with Haydn's "Dictionary of Dates" and "Dictionary of Biography," and will comprise—Acoustics, Astronomy, Chemistry, Dynamics, Electricity, Heat, Hydrodynamics, Hydrostatics, Light, Magnetism, Meteorology, Pneumatics, Statics. These subjects will be treated of by—J. T. Bottomley, M.A., Lecturer on Natural Science in King's College School; William Crookes, F.R.S., &c., Frederick Guthrie, B.A., Ph.D., Professor of Natural Philosophy in the Royal School of Mines; R. A. Proctor, B.A., F.R.A.S.; Richard Wormell, B.A.; and the Editor.

**Gold-Smelting in Irkutsk, East Siberia.**—MM. Basnin and Lomonosoff have opened a private laboratory, in Irkutsk, for the technical study of the minerals, &c., of the country—i.e., the determination of ores, salts, solutions, manures, and materials for building and heating (the determination of paraffin in asphaltum is included). The

laboratories are large, and fitted up with all the necessary apparatus. The titration method will be exclusively used for technical analysis of useful minerals; as far as this method extends, MM. Lomonosoff and Basnin have promised to send us an account of the results of their labours from time to time.

**A Soda Mine.**—Some two miles north of the Sand Springs Road, and fifty miles east of Virginia and Gold Hill, is an immense and apparently inexhaustible deposit of almost pure soda. It is owned by parties in Carson and Virginia, who use it in the manufacture of soap, and also supply quartz mills with it as a chemical agent in the reduction of ores. They also supply it to drug and grocery stores, where it is sold for washing and other purposes for which common soda is ordinarily used. It is free from all earthy matter, and consists of 80 per cent soda, the balance being salt, or something of the sort. The deposit is in the midst of an alkali flat, of some 17 acres in extent, and at the surface it appeared only about 3 feet wide, or rather more like a soda spring than anything else, the pure article forming in a crust over and about the strong watery solution. Upon digging beneath this, however, the solid soda was discovered in a defined mass, like a quartz ledge. A shaft has been sunk beside it to the depth of 50 feet, from the bottom of which a drift has been made 25 feet into the vein or deposit of soda, without getting through it; in fact, very little is known of the depth or extent of this huge deposit of soda, except that there is apparently a million tons or more of it in sight. The enclosing walls on each side are very distinctly defined, and are simply composed of a dark, heavy, compact, iron sand, strongly impregnated with soda. This deposit is as singular as it is valuable, and goes to show how little the varied and inexhaustible resources of our young State are as yet developed.—*Gold Hill News.*

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

*Under this heading will be found an encyclopaedic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

*Comptes Rendus des Séances de l'Académie des Sciences, March 7, 1870.*

This number contains the following papers and memoirs relating to chemistry and physical sciences:—

**Electromotive Force of Divers Substances, as, for instance, Pure Carbon, Gold, Platinum, &c., in the Presence of Water and other Fluids.**—E. Becquerel.—This paper contains the description of a series of very accurate experiments made with chemically pure substances. Among the curious facts elicited is this, that pure gold, obtained from the French Mint, is acted upon by pure water in a manner not hitherto explained, but which gives the author occasion to ask whether, possibly, gold does not contain another substance, which has not been discovered, or whether, perhaps, the slow action of the water is not the cause of the disaggregation of the gold, and thus explains the fact of its being found in rivers in the state of dust.

**Elucidating Remarks on M. Charles.**—J. Dupuis.—In the meeting of the 7th of February last, mention was made of some papers, manuscripts, and books presented to the Academy, formerly the property of the celebrated physicist, Charles. It appears that some confusion has arisen, since there have been two scientific men bearing this surname—viz., Jacques, born at Cluny, a celebrated mathematician, who died on the 22nd of August, 1791; and Jacques Alexandre César, born at Baugency, on the 12th of November, 1746, who died in 1823, and it is this latter celebrated physicist whose papers, memoirs, &c., have been accepted by the Academy for its library.

**Observations of the Colours Exhibited by Rarefied Gases when Submitted to Spectrum Analysis.**—J. Dubrunfaut.

**Electromotive Force which Platinum Evolves when brought into Contact with Divers Liquids.**—J. M. Gauguain.

**Formation of Icicles.**—Lecoq de Boisbaudran.—A paper illustrated with several woodcuts, absolutely necessary for it to be properly understood.

**Illumination of Transparent Bodies.**—M. Soret.

**Absence of Oxygenated Water in the Snow Fallen at Rouen.**—A. Houzeau.—This paper contains an account of very carefully executed experiments to detect the presence of peroxide of hydrogen (*eau oxygénée*) in water obtained from snow, care being taken to prevent the loss or decomposition of the peroxide alluded to. The author's opinion is that, since the experiments made at Kasan undoubtedly proved the presence of the peroxide of hydrogen in snow water, there may exist an essential difference, caused by the locality where it falls. Kasan is situated almost in the centre of the Russian empire, far away from any seas or oceans.



**Poisoning with Hydrocyanic Acid and Cyanides.**—M. Bonjean.—This paper contains a very interesting account of a series of experiments made with living animals, in order to establish positively whether, after their death, such substances as hydrocyanic acid and cyanides can be detected with perfect certainty by chemical analysis. The contents of the paper are too lengthy for full and useful abstraction, but deserve attention, especially for medico-legal questions.

**Rain of Sand which occurred in Italy on the 13th and 14th of February last.**—Rev. P. Denza, S.J.—This lengthy memoir contains the account of a very curious phenomenon—viz., rain, in the southern parts of Italy, accompanied by a fall of a fine reddish sand, while, in the northern parts of that kingdom, snow fell accompanied by the same substance. The sand has been tested, and found identical with that which is now and then carried by gales of wind from the African desert, not simply into Italy, but even sometimes into Switzerland, where some of it fell, along with snow, at Tscappina (Canton des Grisons). This paper contains many curious facts relating to a phenomenon which is sometimes observed also on the Canary Islands.

**Action of Ozone upon Nitroglycerine, Dynamite, and other Explosive Substances.**—J. Joulet.—According to the author's experiments, nitroglycerine, dynamite, iodide of nitrogen, chloride of nitrogen, and some other similar compounds explode the very moment they are brought into contact with ozone; so that, for instance, a drop of nitroglycerine, introduced into a vessel containing ozone, causes an instantaneous explosion. Picrate of potassa gunpowder and ordinary gunpowder are slowly decomposed by ozone, a decomposition which, as regards the last-named substance, takes several weeks before it is perceptible.

*Les Mondes*, February 24, 1870.

**Solar Temperature, and the Means by which it is Kept up.**—Rev. A. Secchi, S.J.—The *resumé* of this memoir, originally published in the Italian language, is given in the following few lines:—The sun is a globe possessed of an enormously-high temperature, undoubtedly reaching many millions of degrees; but our means of estimating that temperature are very imperfect. As to the origin of this high degree of heat, it may have been the result of the force of gravitation which has united the elements of which the central point of the system (viz., of our solar) has been made up; the initial temperature, therefore, the result of mechanical action, will, of necessity, have been far greater than the present temperature of the sun is, which is certainly cooling down. However great this loss of heat may be, it is imperceptible to us, since it is slowly taking place, and partly compensated by chemical actions which take place in the sun, which is, in all probability, in its interior, a mass of strongly-compressed and condensed nebulous matter.

**Handbook of General Cosmography.**—H. J. Klein.—This is highly eulogised as a compendium explaining, in a clear and precise style, everything at present known of our solar system and its constitution. The author has followed, as pattern, the celebrated von Humboldt's *Cosmos*.

**Cleansing of Raw Sugars, and Extraction of Sugar from Molasses, by means of the Saccharate of Hydrocarbonate of Lime.**—J. Boivin and T. Loiseau.—Under the name of *sucrate d'hydrocarbonate de chaux* (saccharate of hydrocarbonate of lime), the authors describe, but do not exactly define, a peculiar compound of lime-water and sugar, to which some peculiar properties are ascribed. The main gist of the paper is a lengthy account of an enumeration of the processes in use for refining sugar at the refinery of MM. Sommier and Co., La Villette, Paris, according to the system of the authors, but any one acquainted with sugar refining will at once perceive that the paper is vaguely worded, and that there is a want of precision in it.

**Apparatus for Heating the Feed-Water for Steam Boilers.**—H. N. Wateso.—This contrivance, which could not be well understood without the reproduction of the cut, is an ingenious arrangement, well deserving the attention of those who wish to save fuel. Emile Leroux, C. E. 43, Rue de Verneuil, Paris, gives full particulars on this subject.

**Tungsten Blue.**—Tessié du Motay.—Dissolve, in a sufficient quantity of water, and successively, 10 parts of tungstate of soda, 8 of tin-salt (protochloride of tin), 5 of ferrocyanide of potassium, and 1 of perchloride of iron. When all these substances are dissolved, the mixture is thoroughly stirred up, and the sediment which is formed is separated by filtration. As soon as the liquid has run off, the moist pasty matter is spread out in thin layers upon suitable glass plates, or shallow dishes, and for several days exposed to the action of strong daylight and sunshine. This slowly causes the formation of a beautifully-blue pigment; and this action may be accelerated by washing the material, so as to remove the matters soluble in water which it yet contains. The blue material has a great similarity with Prussian blue, but differs from it by not being bleached by sunlight; akin to Prussian blue, it resists the action of acids, but not of alkalis. The tungsten blue can be heated to about 180° without decomposition. Its percentage composition, in 100 parts, is—Water, 7.85; tin, 31.69; iron, 5.13; cyanogen, 19.41; blue oxide of tungsten, 35.60; total, 99.68. This blue is not affected by artificial light at all, and is sold at the same price as the very best quality of Prussian blue.

**Oxyhydrogen Light.**—Tessié du Motay.—A lengthy paper, setting forth chiefly matters of domestic economy, as regards the cost of this mode of illumination, and also detailing improvements made whereby the use of lime or zirconia cylinders is replaced by a suitable system of carburization of the hydrogen gas.

March 3, 1870.

**Prize Questions Proposed by the Royal Belgian Academy of Sciences, at Brussels.**—(We do not quote those belonging either to pure mathematics or natural history). The study of electrical induction currents, based, as much as possible, upon a new series of experiments to be made. A new series of researches to be made, with the view of establishing the chemical composition and the mutual relation existing between the albuminoid substances. A gold medal (value £40) will be given for a successful answer to the last-mentioned question, while the value of the gold medal to be given for the reply to the other question will be £24. Answers, written in Latin, French, or Flemish languages, to be sent, post-paid, to M. Guételet, the perpetual secretary, on or before June 1, 1871.

**Prize Questions Proposed by the Bataafsche Genootschap (Batavian Philosophical Society) at Rotterdam.**—We only quote such as belong to chemistry or allied sciences. Determination of the temperature of the water of the oceans at great depth, and in such localities (latitude and longitude) where these determinations have not yet been made; crystallographical examination of such organic compounds as are sufficiently developed to recognise the cleavage of the crystals; determine whether any parts of the sun's surface are possessed of a higher temperature than other portions thereof, and also whether the hotter portions are always the same; the experimental determination of the temperature of decomposition of several chemical compounds, and the estimation of the influence exercised thereupon by the presence of different other substances, and other conditions which may modify that temperature; with at least three liquids, the influence has to be determined which is exercised upon electrolysis when the electrolyte is submitted to pressure: verify, at the same time, whether the facts observed confirm the principle of the conservation of force. By a sufficient number of well-authenticated facts, the question should be settled whether steam boiler explosions are due to a formation of hydrogen gas (decomposition of water), or to the sudden conversion into steam of water previously converted into the spheroidal state; the estimation of the resistance to a galvanic current by liquid mixtures (amalgams in liquid state) of mercury and zinc, and mercury and gold, care being taken that the precise proportions of the metals mixed together, the sp. gr. of each mixture, and the thermo-electric properties such amalgams might possess, be simultaneously indicated; historico-critical account of the observations hitherto made of the electric currents produced in telegraphic wires by thunderstorms and Aurora Borealis. Answer to the question whether any other molecular variations than those produced by the increase of the temperature of bodies affect the rays of the spectrum peculiar to such bodies. Decisive experiments to be taken in order to settle the question between Dr. Tyndall and Prof. Magnus, concerning the greatest absorption of heat by air charged with aqueous vapours. Test, by a series of entirely new experiments, the truth of Dr. Gauguin's statement that conducted electricity is propagated through matter, while free electricity is propagated through the ether. What is the cause of the volcanoes of the Indian Archipelago? The precise estimation of the degree of solubility of gases in liquids, to be determined for at least four gases and eight fluids; the rules generally given for the placing of lightning conductors on buildings should be tested, if possible, by experiments and observations, and therefrom fixed rules established; the more extended study should be made of the conductivity of those electrical conductors termed, by Dr. Gauguin, imperfect conductors; theory, by confirmation, of Holtz's electrical machine; explanation of the phenomena of the spontaneously-becoming charged with electricity of electric conductors placed underground, or under water, and the means to prevent, or, at least, to neutralise, the effects thereof. For the best answers, a gold medal, value £15, or the money-value, with an additional premium of from £5 to £12; a silver medal for the next best answer. Answers written in Dutch, French, English, German, or Latin languages, accompanied by a sealed billet, bearing outside a motto, and inside the author's name, to be sent, post-paid, to Dr. F. van der Pant, at Rotterdam, on or before the 1st of February, 1870.

**Measurement of Forces.**—M. Coste.

**Movement of the Sea.**—J. Quenaut.—This author writes from Montmartin-sur-Mer, and, among other things, states that, according to authentic documents, the islands of Jersey and Guernsey have sunk down, during the lapse of the last 500 years, at least 13 metres.

**Capital Punishment by means of the Guillotine.**—Dr. E. Decaisne.—We simply quote the title of this paper, very opportunely published, since it contains full explanation and sound refutation of the nonsense which has appeared in print of late concerning the retention of vitality, and even consciousness, after decapitation by this machine, introduced in France in 1791.

March 10, 1870.

**Candle-Bearing Tree.**—This curious tree is only met with near the river Chagres, in the Isthmus of Panama, and was discovered there by Dr. Siemann. It is the fruit of this tree which so perfectly resembles, in shape and colour, that of unbleached wax candles, which has given rise to its popular name, *palo de velas* (candle tree); the botanical name is *Parmentiera cerifera*, and its fruit is eaten by sheep. The fruit known as *quamxilotte*, and eaten by the Mexicans as a delicacy, is produced by the *Parmentiera pendulus*.

**Secreting Organ of, and the Secretion of Sulphuric Acid by, Gasteropode Molluscs.**—Paolo Panceri.—Very little is at yet known about the chemical nature of the various fluids produced in and secreted by the non-vertebrated animals. The lengthy paper here quoted describes a very curious phenomenon of the mollusc known as *Dolium galea*, which sometimes grows to a very large size. The saliva of this animal is a colourless, somewhat opalescent liquid, of from 1.025 to 1.030 sp. gr., containing, in 100 parts—Free sulphuric acid, 3.42; combined sulphuric acid, 0.2; combined hydrochloric acid,



0.58; potassa, soda, magnesia, oxide of iron, phosphates, and organic matter, 1.8; water, 94.0. This paper contains, moreover, an anatomical and physiological account of the secretory organs of this animal.

**Improved Coffee-Roasting Machine.**—M. Marchand.—There is a woodcut annexed to the description of this contrivance, which has been very favourably reported upon by a committee of the Chemical Department of the Société d'Encouragement de l'Industrie Nationale.

*Revue des Cours Scientifiques de la France et de l'Etranger*, March 5, 1870.

From this number, which does not contain any papers relating to chemistry or allied sciences, we learn that M. Delaunay has been appointed Director of the Imperial Observatory at Paris, in lieu of M. Le Verrier.

**The Elsass during the Tertiary Period.**—J. Delbos.—An interesting geological paper.

*Cosmos*, March 5, 1870.

**Heating of Steam Boilers.**—A. Scheurer-Kestner and E. Meunier.—The authors have made, on the large scale, a series of experiments which prove that only about 60 per cent of the heat given off by the combustion of coals is really utilised, and the loss is due to the radiation of the exterior surfaces of the boilers. The authors are of opinion that improvements should be directed towards the prevention of this loss of heat; they, moreover, find that the cleaning of the inside of the boilers has great influence, and suggest that this operation of cleaning should be done at short intervals of time.

**Preservation of Milk.**—Add to every litre (1½ pints, and 5 oz.) of unskimmed milk, previously poured in a well-annealed glass bottle, 40 centigrams (about 6 grs.) of bicarbonate of soda. Place the bottle containing the milk, and well corked, for about four hours in a water-bath heated up to 90° (194° F.). On being taken out, the bottle is varnished over with tar: and in that state the milk it contains will keep sound and sweet for several weeks.

**Large Fir Tree.**—There has been just cut down, at Arwa, in Hungary, a fir tree, 139 ft. high, and 71 inches in diameter at 2 ft. from the soil. This tree, as regards size, is a specimen now very rarely met with in Europe, though more common to America.

**Solid Bisulphide of Carbon.**—Dr. von Wartha.—This has been obtained by the rapid evaporation of this liquid itself in the same way as solid carbonic acid is formed. The solid sulphide melts at 9° F., and has the appearance of small cauliflowers.

*Bibliothèque Universelle et Revue Suisse.—Archives des Sciences Physiques et Naturelles*, No. 145,

This number, and the following (No. 146), do not contain any original papers relating to chemistry or allied sciences.

*Monatsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin*, November, 1869.

The only paper relating to chemistry in this number is a lengthy memoir:—

**Contribution to the History of the Sulphuretted Urea.**—Prof. A. W. Hofmann.—This memoir contains the following subsections:—Desulphuration of the ethyl-sulpho ureas; desulphuration of the diethyl-sulpho ureas; desulphuration of diethyl urea in the presence of ethylamine; desulphuration of diethyl-sulpho urea in the presence of ammonia; desulphuration of monoethyl-sulpho urea; desulphuration of normal sulpho urea.

*Annales du Génie Civil*, February, 1870.

This number contains a paper on the—

**Utilisation of the Heather.**—E. Dromard.—In France, and in a great many other European countries, very large tracts of land are uncultivated and left waste, producing nothing but heather and similar plants. The author's lengthy memoir describes practical methods whereby these plants are employed for the production of charcoal, acetic acid, tar, and other useful products, and the soil so cleared as to become fit for the cultivation of various kinds of fir trees. The contents of this paper are of great interest to agriculturists and landowners.

*Pharmaceutische Zeitschrift für Russland*, December, 1869.

The only original paper contained in this number is the end of the extremely lengthy memoir—

**Monograph on Inuline.**—Dr. Dragendorff.

*Journal für Gasbeleuchtung*, January, 1870.

Although not directly bearing upon the matters generally treated in our journal, we call attention to an excellent paper, illustrated with a series of beautifully-executed engravings, on the—

**Application of Gas Illumination to Theatres.**—L. Diehl.—Considering that these buildings so frequently become the prey of flames, occasioning serious loss of life by their conflagrations, this paper is of great interest to all concerned in such matters.

*Jahrbuch der Kaiserlich-Königlichen Geologischen Reichsanstalt*, No. 4, 1869.

This number contains—

**Contribution to the Mineralogical Topography of Austria and Hungary.**—F. von Vivenot.—This useful and concise catalogue is alphabetically arranged, as far as the minerals are concerned, while the names of the localities are printed in italics.

*Polytechnisches Journal von Dingler*, second number for January, 1870.

This number contains the following original papers relating to chemistry and allied sciences:—

**Possible Causes of Steam-Boiler Explosions.**—Dr. H. Schröder.

**Bessemer Steel and Heaton Steel Processes.**—T. Schinz.

**Colorimetric Carbon-Test of Eggertz.**—Dr. Dingler.—The result of the author's researches on this subject is, that Eggertz's process is only applicable when the same quantities and qualities of raw materials are continuously applied for the production of cast-iron; but the test fails to give good results with iron and steel of different origin, since it has been found that the presence of other substances—viz., sulphur, copper, phosphorus, and silicium—affect the accuracy of the test.

**Chemical Constitution of the Colouring Matter of the Alder Tree.**—F. Dreykorn and E. Reichardt.—It is a well-known fact that the wood of the *Alnus glutinosa*, L., when recently cut, exhibits a series of colourations, rapidly changing from yellow to reddish brown. The authors isolated this colouring matter, which is perfectly insoluble in ether, benzol, and sulphide of carbon, difficultly soluble in absolute alcohol and boiling water, but readily soluble in dilute alcohol in every proportion. The different tests applied to this substance resulted in defining it as a peculiar tannin material; with gelatine solution, it is precipitated, with chloride of iron it yields a green precipitate, and its combinations with the heavy metals are insoluble in water; its formula is  $C_{54}H_{28}O_{22}$ . This material yields, when split up by the action of sulphuric acid, sugar, and a peculiar reddish brown-coloured resinous substance, insoluble in water and ether, difficultly soluble in alcohol, readily soluble in caustic soda solution and in ammonia, from which solutions it is precipitated again by acids. The splitting-up of the substance is represented by—



The memoir describes further, at length, the action of alkalies upon this alder tannin, and the products of the dry, or destructive distillation. The result of these researches is that, by the action of alkalies, there are formed protechusic acid, phloroglucine, and acetic acid. The dry distillation yields pyrocatechine.

**Manufacture of Fatty Acids from the Washing of Wool and the Soap-Suds Thereof.**—Dr. Dingler.—After referring briefly to the researches of Houzeau Muiron on this subject, the author discusses, at great length, this topic; and the chief result is that a material is obtainable, by suitable treatment of the wash-waters of wool, which contains, after the bulk of the water has been removed by pressure, in 100 parts—Water, 10.66; fatty matters, 34.74; sundry organic matters, 22.37; fine sand, 30.32; soluble silica, 0.08; sulphuric acid, 0.28; phosphoric acid, 0.09; oxide of iron and alumina, 0.99; lime, 0.25; magnesia, 0.10; alkalies, 0.12. This material has been applied for the manufacture of gas, 100 lbs. of it yielding 469.25 cubic feet free from sulphur compounds and of far greater illuminating power than good coal gas. The fatty matters can be extracted, if desired by means of sulphide of carbon.

*Journal de Pharmacie et de Chimie*, February, 1870.

This number contains the following original papers:—

**Sulpho-Carbonic Extracts, and their Application in the Preparation of Medicinal Oils.**—J. Lefort.—This is strictly a pharmacotechnical essay, treating, under several separate divisions, on the preparation and properties of extracts (from various medicinal plants) by the employment of sulphide of carbon (refined, of course), and the further application of the extracts thus obtained, to the preparation of medicinal oils.

**Adulteration of Cochineal.**—E. Baudrimont.—The author states that the more common kinds of this dye material are first softened and swollen, by means of steam, and next rolled about in artificial sulphate of baryta, whereby the substance assumes the appearance of a superior article. The fraud can, however, be readily detected, since, in the first place, the genuine article contains only from 4 to 6 per cent of water, and this mode of adulteration increases that quantity to 11 per cent; secondly, the quantity, as well as the quality of the ash, is entirely changed. The author found from 19.5 to 20 per cent of sulphate of baryta in the ash, which, when no adulteration has been attempted, contains no trace of this salt.

**Poisoning with the Berries of the Honeysuckle.**—Dr. Duval. That this plant is rather dangerous, on account of its poisonous properties, is well known, but the climate it is cultivated in has some modifying influence. The case here related did not end fatally.



**Indian and China Isinglass.**—J. L. Souberain.—The author states that the different varieties of this article, as met with in the trade, may be recognised as follows:—Russian isinglass dissolves rapidly and instantaneously in hot water, leaving hardly ever more than at most 2 per cent insoluble residue; Bengal isinglass dissolves readily, but leaves from 7 to 13 per cent of residue. The taste of Russian isinglass is pleasant and sweet; it yields a very firm gelatine, which is perfectly transparent. The Bengal, or Indian kind, often has a fishy taste, and the gelatine it yields is not clear. The Brazilian isinglass yields an opaque, milky-looking gelatine, and its taste is acrid. China isinglass is a rare article in the European markets.

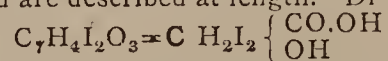
*Journal für Praktische Chemie*, No. 19, 1869.

This number, which, it should be observed, was published only by the end of last January, in consequence of an interruption having taken place by the death of the editors, as well as the publisher, of this periodical, contains the following original papers and memoirs:—

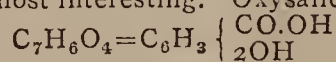
**On the Iodated Salicylic Acids, Oxysalicylic Acid, and Hypogallic Acid.**—Dr. P. Liechti.—In the introduction to this memoir, the author refers to the researches of others on this subject, and states that, as regards the solubility of salicylic acid in water, one part thereof requires, at 10°, 2500, at 18°, 1818, and at boiling temperature, from 15 to 20 parts of that fluid for solution. Monoiodosalicylic acid—



a crystalline substance, anhydrous, and fusing at 184°, but when covered with water, at 98°. One part of this acid requires, at 20°, 893, and at 100°, 104 parts of water for solution. The solutions of this acid and of its salts yield, with chloride of iron, a brilliant violet colouration. The acid contains 48.2 per cent of iodine. Several of the salts of this acid are described at length. Di-iodosalicylic acid—



a semi-crystalline mass, anhydrous, soluble in 1428 parts of water at 15°, and 656 parts at 100°; readily soluble in alcohol and ether; and becomes decomposed when heated to about 197°. The reaction with chloride of iron is the same in this instance as just alluded to. It contains 65.2 per cent of iodine. Among the salts of this acid, the baryta salts are the most interesting. Oxysalicylic acid—



The author says that, notwithstanding there exists a great similarity between this acid and hypogallic acid, he does not think that these substances are identical. Oxysalicylic acid requires 587 parts of water at 21° for its solution, but is readily soluble in boiling water; fusion point, 183°. Even in the cold, this acid reduces an ammoniacal silver solution. The preparation of the oxysalicylic ether is described at great length. In pure state, this substance is a solid crystalline material, fusing at 78°, readily soluble in alcohol and ether, and difficultly so in water. This solution reduces neutral nitrate of silver to the metallic state, even in the cold, and yields, with acetate of lead, a precipitate soluble in acetic acid. Bichloride of mercury is not at all affected by contact with this substance, which also yields with chloride of iron a beautifully deep blue-coloured solution. Opinic and isopinic acids are next described, and the author's researches, compared with those of Drs. Matthiessen and Foster on this same subject. According to Dr. Liechti, opinic and isopinic acids are peculiar modifications of hypogallic acid.

**Action of Permanganate of Potassa upon Quinine.**—Dr. G. Kerner.—One part of pure quinine is dissolved in excess of nitric or hydrochloric acid in such a manner that a bulk of 100 c.c. contains about 1 grm. of the alkaloid; this solution is heated to between 50° and 60°, and there is then added to it a concentrated solution of two parts of crystallised permanganate of potassa in water, care being taken to keep the fluid well stirred. After removal of the peroxide of manganese, the liquid (which should have an alkaline reaction) is evaporated to about one-eighth of its previous bulk, and next acidified, whereby the newly-formed product of oxidation is precipitated. After having been purified, by frequent re-crystallisation from water, aided, for the removal of some colouring matter, by animal charcoal, a hard crystalline substance is obtained, difficultly soluble in cold water and alcohol, but more readily so in these liquids at their boiling temperature. In many respects, excepting taste and alkaline reaction, this substance exhibits properties very similar in character to those of quinine. The formula of this body, which is dihydroxyl-quinine, is  $\text{C}_{20}\text{H}_{24}\text{N}_2\text{O}_4 + 4\text{H}_2\text{O}$ , and its formation from quinine is represented by  $\text{C}_{20}\text{H}_{24}\text{N}_2\text{O}_2 + \text{H}_2\text{O} + \text{O} = \text{C}_{20}\text{H}_{24}\text{N}_2\text{O}_4$ .

**Action of Fremy's Osmiamide upon Animal Tissues.**—Ph. Owsjannikow.—This paper is devoted to the description of the action of Fremy's osmiamide upon tissues—viz., for microscopico-histological use, and has nothing to do with chemistry. What Fremy's compound is meant is not stated.

## NOTES AND QUERIES.

**Anthracene.**—I should be glad to have a simple test for commercial anthracene, and its price, to see whether it would be worth while to make it where pitch is of little value?—TAR DISTILLER.

**Coprolite and Bone in Mixed Superphosphates.**—(Reply to "W. M. B.")—When both the bones and coprolites have been thoroughly dissolved, it will be almost impossible to determine what you desire. If no ammonia salts are present, and the bones applied

not too strongly boiled (exhausted by steam), you might (after drying, of course, at 120 °C.) get some idea by means of the nitrogen estimation.

**Estimating the Amount of Lamp-Black in Graphite.**—(Reply to J. Reddropp.)—In the first place, you might make use of the considerable difference of specific gravity of these two substances, and thus separate them from each other by lixiviation. Since lamp-black (unless purposely purified or re-calcined) always contains a certain amount of empyreumatic matter, you might extract the graphite you suspect with boiling alcohol (methylated spirit will not do in this case), and come to some idea of the amount of lamp-black added to your graphite by the weight of the empyreumatic matter left after complete exhaustion with alcohol and evaporation of the latter. When completely exhausted, an aqueous solution of boiling caustic soda should not, after the graphite (supposed to be mixed as alluded to) has been quietly settled down, exhibit any sign of brownish or yellowish brown colouration.

**Manufacture of Sulphuric Acid.**—The following practical objections to Dr. Hofmann's paper, abstracted by you from the *Berichte der Deutschen Chemischen Gesellschaft*, are suggested by my experience, and I should like to elicit the opinions of others who have had experience in that manufacture. If the steam is regulated so as to make the acid of 1.676 to 1.714 sp. gr., as Dr. Hofmann proposes, there is so much nitric oxide dissolved in it as to act very energetically on the lead of the chamber, the liquor in the gauge-drips becoming thick with sulphate of lead, whilst, as a consequence, the chamber wears out very rapidly. At the same time, if the condensed acid in the saucer of the chamber is drawn off at such a high specific gravity, I find that the dissolved nitric oxide is not got rid of by the subsequent boiling, but that the concentrated oil of vitriol gives off abundant red fumes when diluted, causing great inconvenience to those who use it, and, of course, a waste of nitric acid.—H. B. GIBBINS.

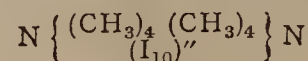
**Analysis of Superphosphates.**—Perhaps some of your numerous correspondents would explain to me how it is that, in the analysis of superphosphates and other phosphatic manures, biphosphate of lime is put down as one of the ingredients it contains, and generally underneath it is placed equal to so much phosphate of lime made soluble. Now, I always understood there was no such substance as biphosphate of lime in a superphosphate, but that the phosphates it contained existed as monocalcic phosphate or soluble phosphate, and tricalcic or insoluble phosphate, and not as biphosphate. If such is the case, why not simply put in the analyses the amount of soluble phosphate, or, if I am wrong, the amount of biphosphate, and not put both? This would simplify matters greatly, as, at present, people that have only a limited knowledge of chemistry are very apt to confound the one with the other, not knowing the difference between them.—R. HOLMES, Roscommon, Ireland.

## MEETINGS FOR THE WEEK.

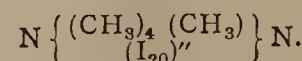
- MONDAY, 21st.—Medical, 8.  
— London Institution, 4.  
TUESDAY, 22nd.—Royal Institution, 3. Prof. Rolleston, on "Nervous System."  
— Institution of Civil Engineers, 8.  
— Ethnological, 8.  
WEDNESDAY, 23rd.—Society of Arts, 8.  
— Geological, 8.  
THURSDAY, 24th.—Royal Institution, 3. Prof. Odling, "Chemistry."  
— London Institution, 7.30.  
— Royal, 8.30.  
— Zoological, 8.30.  
— Royal Society Club, 6.  
FRIDAY, 25th.—Royal Institution, 8. Prof. Rolleston, "Anglo-Saxon Conquest."  
— Quekett Microscopical Club, 8.  
SATURDAY, 26th.—Royal Institution, 3. Mr. Lockyer, "The Sun."

## TO CORRESPONDENTS.

**ERRATUM.**—In Mr. Hartley's paper, on page 110 of our last number  
For—



read—



**Prof. J. Lawrence Smith.**—The receipt of your letter was acknowledged in our columns, and your request has been attended to by our publisher.

**Inquirer.**—The unabridged edition of "Fresenius" is evidently the best.

**M.R.C.S.**—Calley's "Practical Telegraphy" will answer your purpose well.

**C. R. Stevens.**—A work on Dyeing, by the Editor of this paper, is in the press.

**C. A. Grant.**—(1) We do not know the names and addresses of makers of liquid fuel. (2) The Society of Arts, John Street, Adelphi. (3) We have no printed documents; consult *Engineer* or *Engineering*.

**A Subscriber.**—The subject is not suitable for our Notes and Queries column; you had better advertise for the information.



# THE CHEMICAL NEWS.

VOL. XXI. No. 539.

## EXPERIMENTS ON SOME OF THE METHODS FOR EFFECTING THE SEPARATION AND ESTIMATION OF ARSENIC AND COPPER.\*

By E. W. PARNELL.

PROBABLY the oldest and most universal method for effecting the separation of these metals is to treat the mixed sulphides with a solution of an alkaline sulphide, in which the sulphides of arsenic are soluble. Another method is to treat the sulphides with a solution of caustic soda or potash, and conduct a slow stream of chlorine gas into the mixture: the arsenic forms arseniate of soda soluble in water, while the copper is in the form of an insoluble oxide. A third method is to conduct a slow stream of chlorine gas over a mixture of the two metals, sulphides, or otherwise, heated by the flame of a Bunsen's burner: volatile arsenic-chloride is formed, which, when received in water, forms arsenic and hydrochloric acids; the copper remains behind. Another method is to convert all the arsenic into arsenic acid, by treatment with nitric acid or otherwise; add excess of ammonia, and throw down the arsenic as a double arseniate of ammonia and magnesia by the "magnesia mixture;" the copper remains in solution.

The author has attempted to show, by the following experiments, how far accurate results may be obtained by these and other methods of separating the metals, and also by the methods generally used for their estimation.

### *The Separation of the Metals.*

A pure solution of copper was prepared, by dissolving pure, re-crystallised copper-sulphate in distilled water. Pure, freshly-sublimed arsenious oxide was dissolved in a boiling solution of sodium carbonate, to form an arsenic solution. Mixtures of these two solutions were used for experimenting on the methods of separation.

### *Treatment of the Metallic Sulphides with an Alkaline Sulphide.*

A mixture was made from the above solutions, containing about 0.3 gm. of each of the metals. Excess of hydrochloric acid was added, the metals thrown down by sulphuretted hydrogen, the mixed sulphides introduced into a flask, covered with a colourless solution of sodium sulphide, and maintained at a gentle heat on the water-bath for about twelve hours. The liquid was then filtered off, the filtrate separated, and the copper-sulphide on the filter washed with boiling water, to remove every trace of soluble arsenic. The copper-sulphide was then dissolved in nitric acid, the solution evaporated with a small quantity of sulphuric acid, the residue dissolved in water, again treated with sulphuretted hydrogen, the precipitate treated as before with perfectly pure sulphide of sodium, and filtered. The clear solution that would have contained any arsenic that had remained with the copper in the first instance was decomposed with hydrochloric acid, the precipitated sulphur collected, washed, and treated with ammonia, which would dissolve any sulphide of arsenic that might be mixed with it. A little sodium-carbonate was added to the ammoniacal solution, and the liquid evaporated to dryness in a small porcelain dish, the residue mixed with a little potassium cyanide, and the mixture examined for arsenic, by heating it in a glass

tube in a slow stream of carbonic acid, in the manner described in Fresenius's "Qualitative Analysis" (German edition, p. 180). A very faint mirror of metallic arsenic was obtained, that could not exceed 1-10th of a milligramme.

The filtrate from the first treatment with sodium sulphide was next decomposed with hydrochloric acid, the precipitate thoroughly washed and dried, and carefully sublimed. No trace of copper remained as a residue. From this, therefore, I conclude that a satisfactory separation can be effected by using a colourless solution of sodium sulphide.

The fact of ammonium sulphide dissolving small quantities of copper sulphide being so well known, the author did not consider it necessary to experiment on this method.

### *Separation by Conducting Chlorine Gas into an Alkaline Solution in which the Sulphides are Suspended or Dissolved.*

A mixture was made, as in the preceding experiment; excess of a solution of potash was added, and a slow stream of chlorine conducted into the liquid until the latter was thoroughly saturated with the gas. The mixture was then boiled, filtered, the insoluble part well washed, and the precipitate and filtrate examined respectively for arsenic and copper, as in the previous examination. The copper was perfectly free from arsenic; but the filtrate contained a small quantity of copper (this was, however, probably due to minute particles of the oxide of copper being carried through the filter, as the oxide was in an exceedingly fine condition: the quantity was very small). Care should be taken to ensure a decided excess of the chlorine, or a considerable quantity of arsenic may remain with the copper. I conclude, therefore, that this method can yield accurate results.

### *Separation effected by Heating the Mixture in a Stream of Chlorine Gas.*

A similar mixture to those used in the previous experiments was prepared, excess of hydrochloric acid added, the metals thrown down by sulphuretted hydrogen, the precipitate thoroughly dried and introduced into a bulb-tube, and the separation proceeded with precisely as described in Fresenius's "Quantitative Analysis." A large quantity of copper was found to be carried over with the arsenic into the condensing-tube; this would indicate that the heat had been far too high. The next step was to discover at how low a temperature all the arsenic could be decomposed and volatilised. With this object, about 1.0 gm. of pure arsenious trioxide, placed in a small porcelain boat, was introduced into a glass tube; this latter passed through an air-bath, fitted with a thermometer to enable the tube to be maintained at a fixed temperature. A slow stream of chlorine gas was conducted through the tube. In about twenty minutes, the arsenic was entirely converted to an oily-looking, yellow liquid—no doubt the terchloride. The temperature of the bath was then raised to and maintained at 100° C. In about half-an-hour, the liquid was entirely volatilised.

About 1 gm. of sulphide of copper was next treated in a similar manner with a cold stream of chlorine gas. The black mass quickly became yellow. In about an hour it was examined for sulphide, by treating a portion of it with water. A considerable quantity remained undecomposed. The temperature of the bath was then raised to 100° C., and the stream of chlorine conducted, as before, over the mass. After half-an-hour it still contained sulphide. The temperature was then raised to 150° C., and the stream of chlorine continued. After four hours the sulphide was not decomposed. In these experiments, the chlorine gas had not been thoroughly dried by passing it through a tube containing chloride of calcium. It occurred to me, therefore, that the small quantity of moisture the gas would contain might retard its action on the sulphide. To discover if this were the case, a similar

\* Communicated by the Author. Conducted in the Laboratory of Professor Fresenius, Wiesbaden.



quantity was taken, very carefully dried, and treated as before with a stream of the cold, but now thoroughly dried, gas. In about half-an-hour, a portion of the sample was examined for sulphide; it contained only a very small quantity. The action was continued in the cold for about  $1\frac{1}{2}$  hours, a minute trace still remained; on warming the tube to about  $150^{\circ}\text{C}$ ., and continuing the chlorine stream, this trace quite disappeared.

A mixture of copper and arsenic was then again prepared from the solutions, converted into sulphides as before, filtered, washed, and thoroughly dried. The mixture, contained in a porcelain boat, was introduced into the glass tube. This tube was allowed to project for about 4 inches beyond the air-bath. Perfectly dry chlorine was then conducted over the mixture, maintained at a temperature of about  $200^{\circ}\text{C}$ . In about half-an-hour the action was stopped. The projecting part of the tube, which had been almost cold during the operation, was examined for copper. It contained no trace. The copper in the porcelain boat was found to be completely soluble in weak hydrochloric acid. The solution was precipitated with sulphuretted hydrogen, the precipitate treated with sodium sulphide in a warm place for about four hours, the mixture filtered, and the filtrate carefully examined for arsenic, as before. It did not contain the slightest trace. I gather, therefore, from these experiments that, if proper precautions be taken to ensure perfect dryness of the mixture and the gas, a most perfect separation can be effected at a temperature of about  $200^{\circ}\text{C}$ . To avoid the formation of the globule of sulphur, or mixture of chloride of sulphur and sulphur, which often takes place in the condensing-tube, the precaution should be taken to first saturate the liquid with chlorine, or to use a solution of chlorine for the condensing-liquid.

#### *Separation by Igniting the Mixed Sulphides in a Stream of Hydrogen Gas.*

This process, conducted in the usual manner, has only for its object the estimation of the copper, unless, indeed, the amount of sulphur in the mixed sulphides is accurately known, when the amount of arsenic may be calculated from the loss.

To effect the separation, the mixture is introduced into a small porcelain crucible, fitted with a perforated cover and tube for conducting in the gas. A little sulphur is added, a gentle stream of hydrogen conducted into the crucible, and the mixture carefully heated by the lamp, and finally raised to bright redness. A mixture of the two metals was thrown down, as before, with sulphuretted hydrogen, and ignited as just described. The subsulphide of copper was subsequently very carefully examined for arsenic; it did not, however, contain the slightest trace.

#### *Experiments on the Methods for Estimating Arsenic.*

About 3.5 grms. of pure, dry arsenious oxide were carefully sublimed in a slow stream of dry air. This re-sublimed arsenious oxide was then weighed, (it equalled 2.4090 grms.), and dissolved in a boiling solution of carbonate of soda. I purposed diluting this solution to a certain volume, and measuring off portions for the various estimations. To ascertain the extent of the error that this mode of procedure would introduce, the following experiment was made:—A flask of about 300 c.c. capacity, with rather a narrow neck, was carefully marked, and filled to the mark with distilled water. The water in the flask weighed 281.51 grms. 20 c.c. of the water were then measured off, by a pipette, into a small, weighed beaker. The pipette was allowed to drain for about half-a-minute, resting against the side of the beaker, immediately above the liquid.

The weight of water was found to be—

	grms.
In the first trial .. ..	20.037
In the second trial .. ..	20.032
In the third trial .. ..	20.035
Average of the three trials ..	20.034

The greatest difference was 3 milligrammes, equivalent to 0.015 per cent. The extent of the error was, therefore, exceedingly small. The solution of arsenious oxide was introduced into the flask above mentioned, diluted to the mark on the neck, and the temperature noted. 20 c.c. of the solution contained, therefore, 0.17145 gm. arsenious oxide.

#### *Estimation by Precipitation as Double Arseniate of Magnesia and Ammonia.*

This mode of estimating arsenic (and, indeed, most others) necessitates the use of a weighed filter. The filter is first thoroughly dried in the water-bath, and usually allowed to cool between a pair of well-fitting watch-glasses. In this manner, it is very difficult to get accurate results: though the watch-glasses may fit very perfectly, the weight of the filter will rapidly increase after being taken out of the exsiccator.

To more perfectly protect the filter from external moisture, the holder about to be described was substituted for the watch-glasses. A test-tube of about 18 m.m. diameter was cut off about 10 centimetres from the closed end. A second test-tube was then selected, which fitted tightly over the first. The latter was then melted at a convenient distance from the end, and closed, so as to form a small and almost air-tight cover for the first tube. A dry filter, held in the old manner, between watch-glasses, absorbed, in a few hours, 14 milligrammes; while a filter in the holder described, in the same position, and in the same time, had absorbed only 0.6 milligramme.

Twenty c.c. of the arsenious-acid solution were measured off into a small beaker, neutralised with excess of acid, and chlorine conducted into the solution to strong excess. Ammonia was then added, and the arsenic acid precipitated by the "magnesia mixture," and proceeded with precisely as described in Fresenius's "Quantitative Analysis." The filter and precipitate were dried for two or three hours, at a temperature of  $110^{\circ}$ .

	grms.
Holder + filter + precipitate weighed	8.1970
Holder and filter .. ..	7.8892
Double arseniate .. ..	0.3078
Correction for filtrate (101 c.c.) ..	0.0063
	<hr/> 0.3141

Equivalent to arsenious acid .. .. 0.1636

A result which is far too low.

Twenty c.c. were treated precisely as before, but with additional care, to ensure the complete oxidation of the  $\text{As}_2\text{O}_3$  to  $\text{As}_2\text{O}_5$ . The precipitate was dried at  $110^{\circ}\text{C}$ . until the weight remained constant.

	gram.
The precipitate weighed .. ..	0.3095
Correction for filtrate (93 c.c.) ..	0.0058
	<hr/> 0.3153

A result still very much too low.

A third quantity was measured off, and this time was oxidised by conducting chlorine gas into the alkaline solution without addition of hydrochloric acid.

	gram.
The weight of the precipitated arseniate (together with corrections for the filtrate) equalled ..	0.3244
Equivalent to arsenious oxide .. ..	0.1690

A result still too low.

Another portion was measured off, and proceeded with precisely as the last. The precipitate corresponded to 0.1670 gm. arsenious acid—a result still unsatisfactory.

The irregularity of these results led the author to conclude that either the correction for the filtrate is incorrect, or that the formula  $(\text{AsO}_4, \text{Mg}, \text{NH}_4)_2\text{H}_2\text{O}$  does not represent the composition of the compound after being dried at  $100^{\circ}$ — $110^{\circ}\text{C}$ . To discover if the former were the case, a



filtrate from one of the previous estimations, measuring 76 c.c., was neutralised with hydrochloric acid, and treated at a gentle heat for some hours with a slow stream of sulphuretted hydrogen, until all the arsenic was completely precipitated. The precipitate was filtered off, washed, dried, treated with  $\text{CS}_2$  to remove any free sulphur that might be present, and weighed. The weight equalled 0.0019 gm., corresponding to 0.0029 of the magnesia precipitate. The correction usually made (namely, 1 milligramme for every 16 c.c.) would indicate a larger quantity than this, namely, 0.0047 gm.; so that an error from this source would render the result too high, instead of, as the case is, too low.

To discover the composition of the magnesia precipitate after being dried at  $110^\circ \text{C}$ ., the pure precipitate was prepared in the following manner:—A quantity of pure arsenious oxide was powdered, and treated with strong nitric acid, to convert it into arsenic acid. The acid liquid was neutralised with ammonia, diluted, and precipitated with a solution of magnesium sulphate, care being taken to avoid an excess of the latter. The precipitate was well washed, first by decantation, subsequently on a large filter, with pure distilled water, and then thoroughly dried over sulphuric acid. A portion of it (about 1 gm.), further dried for thirteen hours over sulphuric acid, lost 0.0002 gm.

1.6822 gm. was dried at a temperature of  $100^\circ \text{C}$ . for three hours. It lost 0.6319 gm. For two hours longer, it had lost 0.6329 gm. The total loss amounted to 37.62 per cent; theory would lead us to expect only 34.25.

0.6059 gm. was then dried in the water-bath, the temperature of which, however, was not much above  $90^\circ \text{C}$ .

	gm.	per cent.
After 12 hours it lost..	0.2020	= 33.34
„ 18 „ „ ..	0.2036	= 33.59
„ 24 „ „ ..	0.2054	= 33.80

No further decrease in weight took place.

1.0152 grms. were again heated in the air-bath.

	gm.	per cent.
4 hours at $100^\circ$ — $107^\circ \text{C}$ . lost	0.3745	= 36.88
„ „ „ $105^\circ$ — $110^\circ$ „ „	0.3867	= 38.10
3 „ „ „ $105^\circ$ — $110^\circ$ „ „	0.3927	= 38.60

All of which are much above the theoretical loss.

The next step was accurately to ascertain the composition of the precipitate, dried over sulphuric acid. For this purpose, 1.0894 grms. were dissolved in hydrochloric acid, the arsenic precipitated with sulphuretted hydrogen, and filtered off; the filtrate concentrated, neutralised with ammonia, and the magnesia thrown down in the usual manner as a phosphate. The magnesia found equalled 13.92 per cent; the salt should theoretically contain 13.84.

To estimate the amount of ammonia in the salt, 0.2656 gm. was distilled in a small flask with caustic potash, and the escaping ammonia collected in a measured quantity of standard sulphuric acid, the excess of which was subsequently estimated by a standard alkaline solution. The sample contained 8.92 per cent; the theoretical proportion is 8.95 per cent. From these two determinations, I concluded that the formula  $\text{PO}_4, \text{Mg}, \text{NH}_4, 6\text{H}_2\text{O}$  correctly represented its composition.

It is well known that the error caused by heating the sample too highly is due to ammonia which escapes. The next experiment was to discover at what temperature the ammonia commences to be evolved. About 2 grms. of the precipitate, in a small porcelain boat, were introduced into a glass tube, so arranged as to be heated by an air-bath to any desired temperature. Air was drawn, by an aspirator, first through the tube, and then through a few cubic centimetres of pure water, slightly coloured with neutral litmus. The temperature had not been raised above  $80^\circ \text{C}$ ., when ammonia manifested itself by changing the colour of the litmus. A weighed quantity was next operated upon, the tube being heated by a water-bath, and

the escaping gases conducted through a small quantity of standard sulphuric acid. In about an hour, the sample had lost 5 per cent of ammonia. I therefore conclude that, at a temperature of about  $90^\circ \text{C}$ ., ammonia escapes, but more than 1 equiv. of water is retained; while, at a temperature of from  $100^\circ$  to  $110^\circ \text{C}$ ., this excess of water, and probably more ammonia, are driven off; and I therefore consider that no definite compound of arsenic can be obtained by drying the precipitate at a temperature at all suitable for a counterpoised filter. By heating the precipitate strongly to obtain  $\text{AsO}_4, \text{Mg}$ , arsenic invariably escapes. A plan was tried of first evaporating the precipitate with nitric acid before ignition, with a view to form ammonium nitrate, and prevent the reduction of the arsenic; but a loss still took place. Tolerably accurate results may be obtained by dissolving the precipitate in hydrochloric acid, precipitating the arsenic with sulphuretted hydrogen, and weighing it as  $\text{As}_2\text{S}_5$ . The salt, by this method, contained 25.78 per cent, instead of 25.90 per cent. This sulphide cannot be reduced to  $\text{As}_2\text{S}_3$  by treatment with  $\text{CS}_2$ , which leads one to conclude that it is a penta-sulphide, and not, as some maintain, a mixture of  $\text{As}_2\text{S}_3$  and free sulphur.

#### Estimation of Arsenious Oxide by Precipitation as Sulphide.

Twenty c.c. of the arsenious-acid solution were measured off, neutralised with hydrochloric acid, and the arsenic thrown down as tersulphide by sulphuretted hydrogen. The excess of the latter reagent was expelled by conducting carbonic acid into the liquid. The sulphide was collected on a tared filter, washed, and dried at  $100^\circ \text{C}$ . until the weight remained constant. The sulphide weighed 0.2114 gm., equivalent to 0.1701 gm.  $\text{AsO}_3$ .

Another 20 c.c. were treated in precisely the same manner. The sulphide weighed 0.2116 gm., equivalent to 0.1703  $\text{As}_2\text{O}_3$ .

These two results agree together very closely, but are both slightly too low. Probably, if the precaution were taken to avoid a great excess of hydrochloric acid, still more accurate results might be obtained.

The only methods for estimating copper that were experimented on were the well-known plan of precipitating the metal as an oxide by means of a solution of caustic potash or soda, washing well with boiling water, igniting, and weighing; and the plan of igniting either the sulphide or the sulphocyanide with sulphur in a stream of hydrogen gas. The accuracy of the first method is so well established that it is not necessary to give details of experiments. The latter methods also give exceedingly accurate and constant results.

For estimating the amount of arsenic in ores, from the above experiments, I should imagine the neatest, simplest, and most accurate mode of procedure to be to heat the finely-divided sample, in a gentle stream of chlorine gas, to a temperature of about  $200^\circ \text{C}$ ., and to collect the escaping arsenic-chloride in chlorine-water. If free from antimony, the liquid might be well boiled, to expel free chlorine, and the arsenic precipitated with sulphuretted hydrogen, and weighed as  $\text{As}_2\text{S}_5$ ; or it might, perhaps, be better estimated by some volumetric method.

In cases where the arsenic is obtained in the form of  $\text{AsO}_4, \text{Mg}, \text{NH}_4, 6\text{H}_2\text{O}$  (as in separations of the metal from antimony or copper), the most accurate plan would be to dissolve the precipitate in hydrochloric acid, and precipitate the arsenic as  $\text{As}_2\text{S}_5$ . When the amount of arsenic is small, it might be weighed as the double arseniate. The sample should not, however, be dried at a higher temperature than that of an ordinary water-bath—namely, about  $95^\circ \text{C}$ . Perfectly accurate results could, no doubt, be obtained by drying the precipitate over sulphuric acid, when it retains its 6 equivs. of water. The only objection is that it would take days for a filter containing a precipitate to be properly dried by this means.



## ON MICROSCOPICAL MANIPULATION.

By W. T. SUFFOLK, F.R.M.S.

(Continued from p. 126).

## LESSON IV.

*Structure of Wood.*

With the point of a sharp knife, split, *not cut*, thin splinters from a lucifer match or piece of deal. Suitable fragments may often be found at the bottom of a box of matches. Examine with  $O_1$ ; illuminate with PARABOLIC LIEBERKUHN or [*condensing lens*], using DISC-HOLDER or [*stage forceps*] as a support. The splinter will exhibit a fibrous structure, varying in character according to the direction of the split. The simplest structure in this specimen is the cellular tissue crossing the woody fibres; these lines of cells run from the centre of the stem to its circumference, among the fibres and ducts, keeping up a communication between the centre and the growing portion between the wood and the bark, known as the *cambium layer*. The sides of the woody fibres are, in deal, covered with rows of dots, which are characteristic of the *Coniferae*, although they are found in the woody tissues of some few other trees. To see these well, a higher power will be required,  $O_{\frac{1}{2}}$ , and PARABOLIC, or [*spherical lieberkuhn*], and to secure the most favourable position for observation the disc-holder will be found convenient.

To thoroughly investigate the structure of wood, three sections are necessary, one across the stem and two in a longitudinal direction. For the purpose of study, where large and fine specimens are not required, the use of a section machine may be dispensed with, as small sections in any direction may easily be cut with a sharp knife or razor.

The transverse section shows the general arrangement of the tissues composing the stem, consisting of a concentric arrangement of fibres and vessels, of which the cut ends only are seen in this section; the concentric rings represent periods of growth, and usually, but not always, correspond with the number of years the stem has been forming; the *medullary rays* are seen running from the pith in the centre to the circumference—they are developed to an enormous extent in the Clematis, where their grouping in masses gives a marked character to the transverse section.

The other two sections are longitudinal, and are cut, one parallel to the medullary ray and the other across it. The first, or *radial section*, exhibits the sides of the medullary rays; the second, *tangential section*, their cut ends; these are very conspicuous in mahogany.

The structure of the stem of endogenous plants differs considerably from that of exogens, just described; in these, there is no very marked distinction between wood and bark—the rings of annual growth and the medullary rays are wanting, so that a single longitudinal section only is required, instead of the two needed to demonstrate the structure of an exogen (a section of cane will supply a good example). For the histology of plants, see Bentley's "Manual of Botany," Book I. There are many very accurate figures of vegetable tissues throughout Hassall. The knowledge of the minute structure of plants is of the greatest use to the analytical microscopist, as it is by this means alone that mixtures of vegetable powders can be detected. Full details are given in Hassall.

Sections of woods, such as ebony, box, and some others, which are too hard to be cut in the usual manner, may be obtained by grinding, as in the case of bone; this process must also be adopted with cellular tissue, when hardened by deposits of sclerogen, as cherry and plum stones, ivory nuts, coconut shell, and many other hard substances. Soft substances, as leaves, may be cut by being pressed between two pieces of cork, which are sliced with it. Cellular tissue like that of the common rush, which yields so much to the knife that it is pressed aside instead of being cut, should be saturated with melted wax before attempting to make a section; this can be removed from the thin slices with benzol.

(To be continued.)

## THE "WEAPON-SALVE" OF PARACELSUS.

By G. F. RODWELL, F.C.S.

AMONG the more curious of the magical remedies of the sixteenth and seventeenth centuries was a certain ointment, invented by Paracelsus, which, he asserted, would cure all wounds resulting from violence by being applied to the weapon which had caused the wound (or its facsimile), under certain precise and stringent conditions. The directions which are given for the preparation of this unguent vary slightly, according to different authors. It was to be compounded of moss from the skull of an unburied man, gathered under certain planetary conditions, of oil, "mummy," and human blood; while some recommended the addition of the "dried brain of a wilde bore." The most minute directions were given for applying the unguent to the weapon; and a slight carelessness could as easily cause the death of the patient as his cure: thus it was said, "Beware that the weapon fall not downe, nor the winde blow upon it in a cold place, for it will force the patient to madness." Many writers wrote strongly in favour of this cure; among them, Crollius, Baptista Porta, Cardanus, Burgravius, and Coclinius. Lord Bacon alludes to it in his "Sylva Sylvarum" (cent. 10, par. 998), and adds, "though myself, as yet, am not fully inclined to believe it." Robert Fludd, a physician, and a contemporary of Bacon, was one of its staunch supporters.

Now, a certain William Foster, "M.A., and Parson of Hedgeley, in the County of Buckingham," who appears to have been fond of controversy, and dissatisfied with his position in the Church, was particularly bitter against this cure, which he verily believed to be the work of the devil. Full of this idea, he published a brochure of fifty-six pages, in 1631, entitled "Hoplocrisma Spongus; or a Sponge to wipe away the Weapon-Salve. A treatise wherein is proved that the cure late taken up amongst us, by applying the salve to the weapon, is magicall and unlawful." In the preface, Foster, in vindication of the violent attack which he made upon the advocates of this cure, says—"I dare call sin, sin in whomsoever. If Jesabell be painted, with Jehu I will not have peace with her to commend her, though a queene. If Herod be incestuous, with the Baptist I'll not sooth him, though a king. If Simon Magus be a socerer, I feare not his divell; with S. Peter, I'll rouze him, though a witch. Shall anyone, for my boldnesse, think to sit upon my skirts? Let these knowe I esteeme myself *infra invidiam*. I cannot have lesse in the Church, unlesse nothing. And, if they shall endeavour to keep me still low, let them knowe I looke for no good from them that envie my endeavours to do good." Against Fludd, as one of the most recent advocates of the cure, Foster is specially virulent; indeed, the brochure is principally directed at him. At first, Fludd took no notice of the attack, deeming Foster, as he tells us, not worthy of notice; but, finding



one morning that Foster had caused a title-page of the "Hoplocrisma Spongius" to be nailed to each of his door-posts, he was so incensed thereby that he forthwith brought out a brochure of 212 pages in reply. It is entitled—"The Squeezing of Parson Foster's Sponge, ordained by him for the wiping away of the Weapon-Salve. Wherein the sponge-bearer's immodest carriage and behaviour towards his brethren is detected; the bitter flames of his slanderous reports are, by the sharpe vinegar of truth, corrected and quite extinguished; and, lastly, the vertuous validity of the sponge in wiping away of the weapon-salve is crushed out, and thus abolished." On the title-page, Fludd introduces a verse from the 92nd Psalm concerning the fall of the wicked man, and also the somewhat pointed remark—"Opera Dei, vir brutus et stultus, non intelligit." It is to be confessed, however, that he was a good deal provoked. The manner in which the controversy was continued is somewhat amusing, when we remember the subject of it. Foster, after mentioning several men who had advocated the weapon-salve, and indirectly including Fludd amongst them, says—"I wonder at nothing more than that Beelzebub was not in the number." To which Fludd replies—"A singular diabolical conceit. . . . Marry, I will tell him why:—If it had been true that the use of the weapon-salve is witchcraft, and the users thereof witches and conjurers (as he boldly saith), how, I pray you, should Beelzebub be missing from our company? . . . And this is the reason that Mr. Foster and his like have failed to find Beelzebub or the Devil in this number, forasmuch as he is nearer to them than they are aware of."

After vindicating himself, and disavowing all connection with magic and necromancy, Fludd attacks certain of Foster's statements in regard to other matters. "I will proceed now," he says, "to the greatest assault, wherein his sponge rubbeth very hard against my text, but prevaileth no more than they which go about to wash away the colour of a black-moore." He then enters into an elaborate statement to prove that "devils have æery bodies allotted to them in their creation," which Foster had denied. And thus is the foolish controversy continued to the end. The amount of erudition brought to bear upon it is surprising, and worthy of a better theme. An assertion is rarely made on either side without a quotation to back it up, Foster preferring the Fathers of the Church (notably SS. Augustine and Jerome), while Fludd goes back to the ancient Greeks, and to Hermes Trismegistus. They both quote the Scriptures profusely, Foster because he is a clergyman, Fludd because he knows that arguments drawn from that source will most prevail with a Churchman.

We do not hear much more of the weapon-salve. After all, it is scarcely more absurd than some of the beliefs which prevail in the present day in remote country districts—such, for instance, as the cure of warts by rubbing them with a piece of stolen meat. The belief in cures of this nature was rife in the seventeenth century, Bacon asserts many of them. We must remember that the belief in witches and demons, spells, conjurations, philtres, and raisings of the devil, was as firm then amongst all classes of Society as it is now in many a lone hamlet in Cornwall, and many a green village of Galway or of Wales. Of necessity, superstition lingers longest in those places which are most removed from centres of thought and civilisation. There is a conservative attitude of idea about people who are much shut out from the external world. We know a village not two hundred miles from London (which there is no reason to believe differs from other villages distant from large towns) in which there are many Middle-Age superstitions; there is a witch, moreover, who possesses the power of the evil-eye, and those who offend her are sure to suffer, sooner or later, some dire calamity; we have not yet heard of her raising a familiar demon. Now, all this goes on in a village by no means debarred from the progress of civilisation; there is a boys' school with a certificated master,

a girls' school with a certificated mistress, a night-school, a Sunday-school, penny-readings, and occasional concerts, not to speak of a really good village-library. If, then, in this nineteenth century, all manner of rank superstitions are among us (and we have most of us some pet superstition or other), we can scarcely cry shame on the advocates of the weapon-salve two centuries and a half ago. As for Parson Foster, of Hedgeley, he was certainly a man born out of due time.

## QUICK WET ASSAY OF GALENA AND OTHER COMPOUNDS OF LEAD.\*

By FRANK H. STORER,

Professor of Chemistry in the Massachusetts Institute of Technology.

WHEN in contact with metallic zinc, galena is readily decomposed by acids. Even oxalic, acetic, and dilute sulphuric acids are capable, when hot, of decomposing galena,—metallic lead being deposited and sulphuretted hydrogen gas set free,—while with chlorhydric acid the decomposition is peculiarly rapid and complete.

Galena is easily decomposed, also, even in the cold by dilute nitric acid in presence of zinc; but the reaction differs in this case from that just described—not metallic lead but free sulphur is deposited, while nitrate of lead goes into solution.

The reaction with zinc and chlorhydric acid may be employed with advantage for assaying galena, particularly the common American variety, which contains no other heavy metal besides lead. The details of the process are as follows:—Weigh out 2 or 3 grms., or more, of the finely powdered galena. Place the powder in a tall beaker, together with a smooth lump of pure metallic zinc. Pour upon the mixed mineral and metal 100 or 150 c.c. of dilute chlorhydric acid which has been previously warmed to 40° or 50° C.; cover the beaker with a watch glass or broad funnel, and put it in a moderately warm place.

Chlorhydric acid, fit for the purpose, may be prepared by diluting 1 volume of the ordinary commercial acid with 4 volumes of water. For the quantity of galena above indicated, the lumps of zinc should be about an inch in diameter by a quarter of an inch thick; they may be readily obtained by dropping melted zinc upon a smooth surface of wood or metal.

The zinc and acid should be allowed to act upon the mineral during fifteen or twenty minutes in order to ensure complete decomposition. Any particles of galena which may be thrown up against the cover or sides of the beaker should, of course, be washed back into the liquid. It is well, moreover, to stir the mixture from time to time with a glass rod.

When all the galena has been decomposed, as may be determined by the facts that the liquid has become clear, and that no more sulphuretted hydrogen is evolved, decant the liquid from the beaker into a tolerably large filter of smooth paper, in which a small piece of metallic zinc has been placed. Wash the lead and zinc in the beaker as quickly as possible with hot water, by decantation, until the liquid from the filter ceases to give an acid reaction with litmus paper; then transfer the lead from the beaker to a weighed porcelain crucible. In order to remove any portions of lead which adhere to the lump of zinc, the latter may be rubbed gently with a glass rod, and afterwards with the finger or a piece of caoutchouc, if need be. Wash out the filter into an evaporating dish, remove the fragment of zinc, and add the particles of lead thus collected to the contents of the crucible. Finally, dry the lead at a moderate heat in a current of ordinary illuminating gas, and weigh.

The lead may be conveniently dried by placing the

\* Communicated by the Author.



crucible which contains it in a small cylindrical air-battery of Rammelsberg's pattern, provided with inlet and outlet tubes of glass, reaching almost to the bottom of the bath.

When the process is conducted as above described, the lead undergoes no oxidation; hence there is no occasion for igniting the precipitate in a reducing gas. The precipitate needs only to be dried out of contact with the air.

If desirable, the sulphur in the galena could be determined at the same time as the lead, by arresting the sulphuretted hydrogen in the ordinary way.

If the mineral to be analysed is contaminated with a siliceous or other insoluble gangue, the metallic lead may be dissolved in dilute nitric acid, after weighing, and the insoluble contamination collected and weighed by itself. In the case of galenas which contain silver, antimony, copper, or other metals, precipitable by zinc, the proportion of each metal must be determined by assay or analysis in the usual way after the total weight of the precipitated metals has been taken.

Besides galena, almost any of the ordinary lead compounds may evidently be assayed by the method above described. I find, for example, that metallic lead may be precipitated quickly and completely from the sulphate, chromate, nitrate, oxide, and carbonate—and with peculiar ease from the chloride—by means of zinc and chlorhydric acid. The method would furnish an easy qualitative test for the detection of barytes in white lead. When applied to the analysis of nitrate of lead, it would probably be best to decompose the nitrate by means of a solution of chloride of sodium before adding the zinc and chlorhydric acid.

In all these cases the decomposition of the lead salt by the zinc is so complete, that no trace of colouration is produced when sulphuretted hydrogen is added to the liquid decanted from the metallic lead.

The following determinations of lead in a sample of pure galena from Galena, Illinois, were made in the manner above described by my assistant, Mr. A. H. Pearson —

	Grammes of galena taken.	Grammes of lead found.	Per cent of lead found.	Theory.
No. 1.	1.4847	1.2908	86.93	86.62
„ 2.	0.5902	0.5120	86.75	
„ 3.	3.6320	3.1568	86.91	

Attempts to determine sulphur and lead in the same portion of galena, by means of the reaction of zinc and dilute nitric acid, above described, gave no satisfactory results. The free sulphur obtained by treating galena with zinc and ordinary nitric acid, diluted with 3, 4 and 5 volumes of water, always retained a small quantity of lead, while a certain amount of sulphuric acid was found in the clear liquid. It is, in short, well nigh, or quite, impossible to avoid the secondary reactions between zinc and nitrate of lead, and between sulphur and nitric acid which set in as soon as, or just before, the last traces of the galena have been decomposed.

Boston, Feb., 1870.

## ON THE ESTIMATION OF AMMONIA IN ATMOSPHERIC AIR.\*

By HORACE T. BROWN.

In the attempts that have been hitherto made to estimate the ammonia present in atmospheric air, the results arrived at by the various experimenters have differed so widely that it is still a matter of uncertainty what the quantity really is. That it is a very small amount all agree, but the extreme results on record vary as much as from 13.5 to 0.01 part of carbonate of ammonium per 100,000 of air. It may, therefore, not be without interest to give an account of a simple method affording

very concordant and, I believe, accurate results; at the same time being easy of performance and requiring but little time for an experiment.

The apparatus used consists of two glass tubes, each of about 1 metre in length and twelve m.m. bore. These are connected air-tight by means of a smaller glass tube, and inclined at an angle of 5° or 6° with the horizon. Into each of the larger tubes are introduced 100 c.c. of a mixture of perfectly pure water and two drops of dilute sulphuric acid (sp. gr. 1.18). Through this acidulated water a measured quantity of the air under examination is slowly drawn, in small bubbles, by means of an aspirator.

No porous substance must be used to filter the air, for reasons to be stated hereafter. The air is conducted into the absorption liquid through a small piece of quill tubing drawn out to a small aperture at the end, immersed. This tube must be kept quite dry throughout the experiment. Great care must be taken to cleanse perfectly every part of the apparatus with water free from ammonia, and the caoutchouc plugs, or corks, used must be boiled for a short time in a dilute solution of caustic soda.

The stream of air is so regulated as to allow about 1 litre to pass through the apparatus in an hour.

By directing the point of the delivery-tube laterally, each bubble has imparted to it on rising an oscillatory movement, which facilitates complete absorption of the ammonia.

When from 10 to 20 litres of air have passed, the liquid is emptied from the tubes into upright glass cylinders, an excess of a perfectly pure solution of potash added, and then 3 c.c. of a Nessler solution. The standard of comparison is made in the ordinary way, only using acidulated in place of pure water, and neutralising with potash after adding the standard solution of ammonium salt. Beyond somewhat retarding the point of maximum colouration, a little potassium sulphate does not interfere with the delicacy of Nessler's reaction.

If the experiment has been conducted with proper care, at least four-fifths of the total ammonia ought to be found in the first tube. Four or five litres of air are generally quite sufficient to give a decided reaction, but it is better to use not less than 10 litres, as before mentioned.\*

Very many experiments have been made by this method, both on air from the town of Burton-on-Trent, and that of the adjoining country. The air from the town, as might be expected, varies somewhat in composition; much more so than that taken from the open country, as may be seen from the following tables, in which are given some of the numerous results obtained.

The ammonia is calculated in every case as carbonate  $[(\text{NH}_4)_2\text{CO}_3]$ ; for although nitric acid is sometimes found in air, yet its presence must be looked upon as accidental.

In the immediate vicinity of towns some of the ammonia must also be in the form of sulphate, sulphite, or ammonium chloride.

(1). *Air taken from town.* (Taken at a height of 2 metres from ground.)

Date of Experiment.	$(\text{NH}_4)_2\text{CO}_3$ as grammes per 100,000 litres of air at 0° C. and 760 m.m. barom.	$(\text{NH}_4)_2\text{CO}_3$ in parts by weight per 100,000 of air.
1869. Sept. 30	1.12940	0.8732
Oct. 4	0.62117	0.4801
„ 6	0.52510	0.4059
„ 8	0.62117	0.4801
Nov. 26	1.07290	0.8293
„ 28	1.10000	0.8503

\* When the air to be examined is highly charged with ammonia, as that from stables, &c., a perfectly dry bottle of 3 or 4 litres capacity should be carefully filled with a pair of bellows, 100 c.c. of acidulated water introduced, and, after closing securely, the whole well agitated at intervals for three or four hours. The liquid is then poured out, and the  $\text{NH}_3$  estimated by the Nessler solution as usual.

\* A paper read before the Royal Society, March 17, 1870.



(2). *Air from country.* (Taken at a height of 2 metres.)

Date of Experiment.	(NH <sub>4</sub> ) <sub>2</sub> CO <sub>3</sub> as grammes per 100,000 litres of air at 0° C. and 760 m.m. barom.	(NH <sub>4</sub> ) <sub>2</sub> CO <sub>3</sub> in parts per 100,000 of air.
1869. Dec. 6	0.7620	0.5890
„ 8	0.7826	0.6085
„ 9	0.6601	0.5102
„ 11	0.6635	0.5121
1870. Feb. 12	0.7639	0.5904

The direction of the wind does not seem to have any influence on the ammonia found; immediately after heavy rain, however, the quantity falls somewhat below the average, but the air is again restored to its normal condition after a lapse of two or three hours.

Attempts were made to make the method more delicate still by absorbing the ammonia in pure water and then distilling, but the nitrogenous organic matter suspended in the air was found to interfere with the results.

When the air is passed through cotton-wool before entering the absorption-tubes, it is found to be entirely deprived of its ammonia by the filter. This is also the case with air artificially charged with ammonia to a large extent. This absorption is not due to the presence of hygroscopic moisture, since cotton-wool, when absolutely dry, is capable of taking up 115 times its own bulk of dry ammonia (confined over mercury) at 10.5° C. and 755.7 millims. barom.; the gas being again slowly evolved when the wool is left in contact with the air at 100° C.

All other porous substances that were tried for filtering agents were found to possess this property more or less; even freshly ignited pumice-stone is not entirely without absorptive effect upon the gas.

## PROCEEDINGS OF SOCIETIES.

### CHEMICAL SOCIETY.

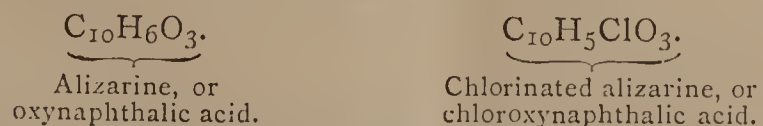
March 17th, 1870.

Dr. A. W. WILLIAMSON, F.R.S., &c., President, in the Chair.

THE following gentlemen were elected fellows:—D. Brown, A. Muirhead, T. L. Patterson, D. Penny, S. T. Smith.

The first paper read was “On Artificial Alizarine,” by W. H. PERKIN, F.R.S.

Alizarine was first obtained from madder in a crystalline state by Robiquet and Colin. Their method of preparation (viz., sublimation) rendered it, however, a matter of doubt whether alizarine existed as such in the madder, or was a product of decomposition of some other body. Dr. Schunk, having succeeded in obtaining alizarine-crystals without taking recourse to sublimation, proved the first view. He gave it the formula C<sub>14</sub>H<sub>10</sub>O<sub>4</sub>; whilst Strecker believed it to be C<sub>10</sub>H<sub>6</sub>O<sub>3</sub>, relating it to Laurent’s chloroxynaphthalic acid, since both these substances yield phthalic acid on treatment with hydric nitrate; in fact, chloroxynaphthalic acid was regarded as chlorinated alizarine—

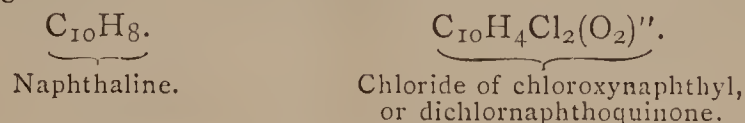


About five years since, Martius and Griess, when investigating the amido-derivatives of naphthol, obtained a colouring-matter possessing Strecker’s formula; yet it was not alizarine, but a body isomeric with it. Some time after the discovery of this supposed isomer of alizarine, Graebe commenced his researches on quinone. This substance, obtained, as early as 1838, by Woskressensky as a product of the oxidation of quinic acid, was regarded by Kekulé as containing two molecules of carbonyl—

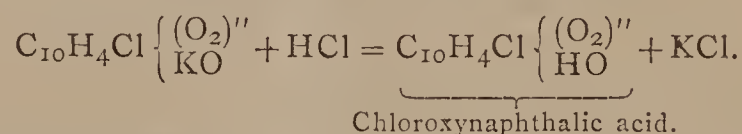
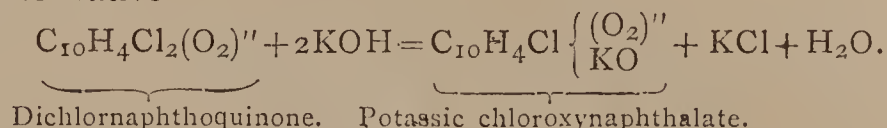
CO=C<sub>4</sub>H<sub>4</sub>=CO. But Graebe, induced by the results he had gained in his investigations of the quinone compounds, viewed it as a substitution-product of benzol, two of whose hydrogen-atoms are replaced by the group [O—O]”, in which half of the combining-values of oxygen saturate each other—



The best-known derivative of quinone is chloranil, or perchloroquinone, which is obtained by heating phenol with potassic chlorate and hydric chloride. When this body, C<sub>6</sub>Cl<sub>4</sub>(O<sub>2</sub>)”, is heated with alkalis, potassic chloranilate, or dichloroquinonate, is formed. According to this reaction, Graebe regarded Laurent’s chloride of chloroxynaphthyl as the dichlorinated quinone of naphthaline—



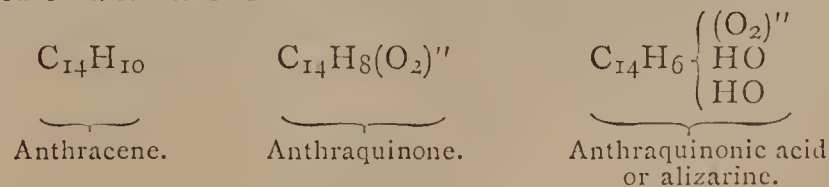
When this naphthaline derivative is heated with alkalis, it behaves like chloranil; but, whilst, in the latter compound, two atoms of chlorine are removed, only one chlorine-atom is displaced in the case of the naphthaline derivative—



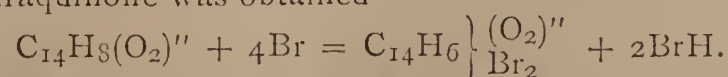
Chlorinated quinones of toluol were obtained by Graebe and Burgmann, by heating cresylic acid with potassic chlorate and hydric chloride—



After it had been shown that chloroxynaphthalic acid was a quinone-acid, Graebe and Liebermann thought it probable that alizarine belonged to the quinone series. To gain some information about the hydrocarbon to which alizarine is related, they heated a specimen of the natural colouring-matter with powdered zinc, according to Baeyer’s method of reducing aromatic compounds; and they obtained a substance of the composition C<sub>14</sub>H<sub>10</sub>. This hydrocarbon formed, with picric acid, a red compound, and, in fact, possessed all the properties of anthracene as obtained from coal-tar. This discovery led Graebe and Liebermann to assume alizarine to be the quinone-acid of anthracene—



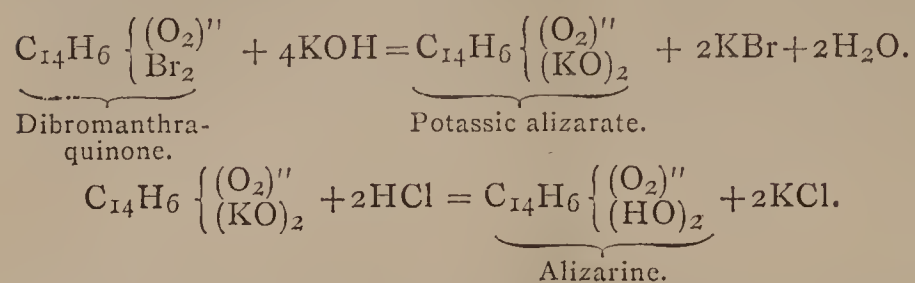
Having obtained anthracene from alizarine, it now remained to produce alizarine from anthracene. Many years ago Laurent had obtained an oxygenated derivative of anthracene of the composition C<sub>14</sub>H<sub>8</sub>O<sub>2</sub>. Graebe and Liebermann at once recognised this as the quinone of anthracene, and now it remained for them only to transform this anthraquinone into the acid by replacing two atoms of hydrogen by two of hydroxyl. For this purpose they heated anthraquinone with bromine, whereby dibrom-anthraquinone was obtained—



On treating this with potassic hydrate at a temperature of about 180° C., the potassium salt of alizarine was ob-

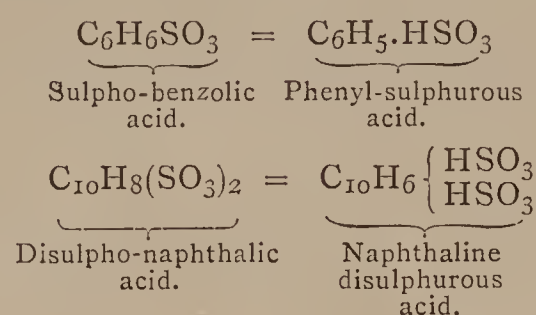


tained, from which the alizarine was liberated by hydric chloride—



By thus producing alizarine from anthracene, Graebe and Liebermann have given the first instance of the artificial formation of a vegetable colouring matter.

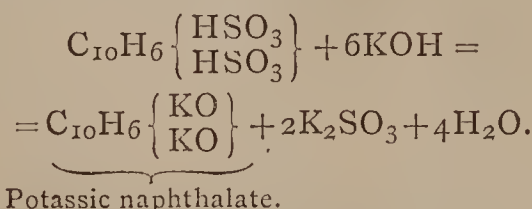
But to turn this beautiful discovery to practical account, to render alizarine from anthracene a substitute for madder, it was necessary to replace the bromine required in the process by some cheaper reagent. It is known that hydric sulphate forms with many organic bodies compounds called sulpho-acids. According to the experiments of Wurtz and of Kekulé these compounds are acid sulphites.



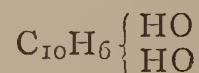
for, when heating sulpho-benzolic acid with potash they obtained a carbolate, and a sulphite—



Disulpho-naphthalic acid yields, by similar treatment, a naphthalenate and a sulphite—



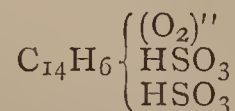
This potassic naphthalate can, by addition of an acid, be transformed into hydric naphthalate,



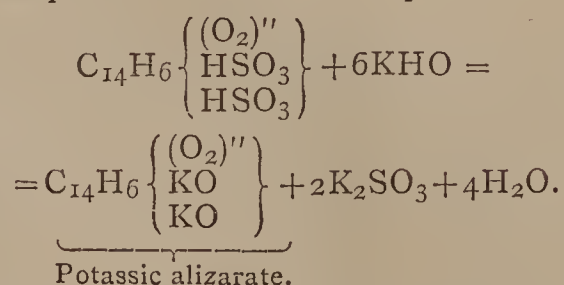
which body stands to naphthaline in the same relation as alizarine to anthraquinone.

It appeared therefore probable that if a disulpho-acid of anthraquinone could be found, the formation of alizarine by a similar process may be rendered possible.

The formation of this sulpho-acid seemed, at first, not very probable, on account of the remarkable stability of anthraquinone, but on strongly heating it with hydric sulphate a sulpho-acid was at last obtained, which, on analysis, was found to be the desired disulphoanthraquinonic acid—

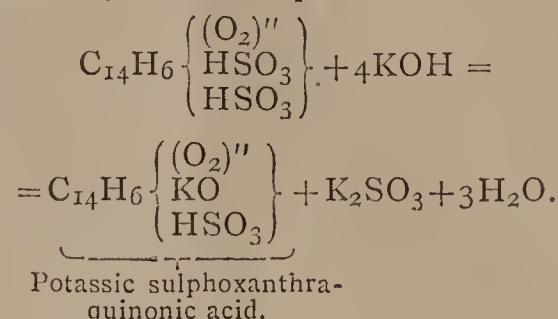


This compound, heated with potassic hydrate to about 180° yields sulphite and alizarate of potash—



from which potash salt the alizarine is thrown down by acids, just as brightly coloured and as pure as the alizarine from dibromanthraquinone.

It is, however, to be remarked that alizarine is not the primary product of the reaction of potash on the sulpho-acid, an intermediate body being first produced, which may be called sulphoxanthraquinonic acid, and the formation of which may be thus expressed:—



This intermediate body is crystalline, of a yellow or orange colour, easily soluble in water, produces, with caustic alkalies, violet or blue solutions, and when heated with potassic hydrate yields alizarine and sulphurous acid.

The process just described may be modified by first forming a disulpho-acid of anthracene, and then converting this by means of oxidising agents into the disulphoanthraquinonic acid.

In the conversion of disulphoanthraquinonic acid into alizarine by the action of potassic hydrate, a peculiar reverse action takes place to some extent, both anthraquinone and anthracene being formed.

Artificial alizarines entirely identical with the colouring matter obtained from the madder root. Both of the products crystallise in needles, which are usually curved, especially when small. They dissolve in caustic alkalies, forming violet solutions of the same tint. When applied to mordanted fabrics they produce exactly the same colours, bearing the treatment with soap equally. They also possess precisely the same tinctorial value. The colours produced on fabrics by the artificial alizarine are as fast against light as those of madder. Cupric acetate produces in their alcoholic solutions a purple colouration. Their alkaline solutions show identical absorption bands in the spectrum. Both yield phthalic acid when treated with hydric nitrate.

It may be observed that a solution of sulphoxanthraquinonic acid in alcoholic potash has a very similar spectrum as an analogous alizarinic solution; but the spectra of the respective aqueous solutions are quite different.

As a substitute for madder artificial alizarine has been objected to, on the ground that pure alizarine alone will not produce the madder colours, other colouring matters being required. But Schunck says that, after a long course of experiments, he has been led to the conclusion, that the final result of dyeing with madder is simply the combination of alizarine with the various mordants employed, and he recommends extraction from madder prints as the easiest method of preparing pure alizarine on a small scale. Mr. Perkin, on experimenting in this direction, could find nothing but alizarine on finished madder print. There is a second colouring matter in the madder root, the purpurine, but this cannot be found in the colour of the prints; if a mere trace of it were present it could easily be detected by its characteristic spectrum. It cannot be affirmed that purpurine never exists on prints dyed with madder or garancin, but it is certain that the higher the class of print, and, consequently, the more brilliant the colours, the purer is the alizarine in combination with the mordants.

Artificial alizarine as sent to the dyer and printer is not exactly pure alizarine, and generally produces, with alumina mordants, a somewhat redder shade than madder. This is due to some impurities, whose nature is, as yet, not known. Schunck has, however, already succeeded in obtaining a yellow crystalline body from the residues; but this yellow substance does not appear to have any affinity for mordants, and therefore cannot be injurious.

A good deal has been said about the supply of anthracene. It must be remembered, however, that far distillers have had as yet but little experience in separating



this substance. Mr. Perkin's investigations on this matter have led him to believe that coal-tar contains considerable quantities of this hydrocarbon. No doubt the kind of coal used as well as the temperature employed in the gas works, influences the quality of the tar as a source of anthracene, but upon these points no definite information has yet been obtained.

Mr. Perkin illustrated his highly interesting lecture by exhibiting samples of fabrics dyed and printed with artificial alizarine, and also by projecting the spectra of some alizarine solutions on a screen.

The following paper was "*On the Combinations of Carbonic Acid with Ammonia and Water*," by Dr. Divers, the reading of which, however, was, on account of the advanced hour, postponed for the next meeting, when, besides this, the following papers will be read: "*Deep Sea Water*," by John Hunter, and "*Refraction Equivalents of Aromatic Hydrocarbons*," by Dr. Gladstone.

In a note published in the CHEMICAL NEWS (vol. xxi. p. 48), and which seems to have escaped Mr. Wright's notice, the following explanation of this is given:—

"These higher results are caused by the liberation of iodine by spontaneous decomposition of hydriodic acid set free by hydrochloric acid distilled over during the process, as the following experiment shows:—A few drops of hydrochloric acid were added to a solution of iodide of potassium. The solution remained for some hours colourless, but, after standing twenty-four hours, had become quite yellow, and was found to contain free iodine sufficient to indicate 3 per cent of peroxide of manganese when titrated with hyposulphite.

Mr. Wright's experiments, though very interesting, do not in the least "account for the results obtained by Messrs. Sherer and Rumpf," since the conditions were not identical.—I am, &c.,

EDWARD SHERER.

4, St. Nicholas Buildings,  
Newcastle-on-Tyne, March 21st, 1870.

## CORRESPONDENCE.

### MANUFACTURE OF SULPHURIC ACID.

*To the Editor of the Chemical News.*

SIR,—With your correspondent Mr. Gibbins I saw the objections to Dr. Hofmann's improvement in the manufacture of sulphuric acid. Still the advantages to be derived from it, especially in the present condition of the nitrate market, are so large that I at once decided on giving it a fair trial, and am now arranging my vitriol chamber so as to obviate one of the difficulties named by your correspondent, and which, if not provided for, would probably be fatal.

The description will, probably, explain my object:—I have, say, six vitriol chambers at work, nearly all of large size; into No. 1 I work one set of furnaces and into No. 2 another set. The gases from No. 1 and from No. 2 meet in No. 3; this and No. 4 I shall work up to 1.715 specific gravity—Nos. 1 and 2 will work at 1.45; all the acid produced in No. 3 will be passed into No. 1 and all produced in No. 4 into No. 2: the acid of 1.715 as it mixes with that of 1.45 will give up its nitric oxide, which thus at once becomes again available and the acid can then be run off for use from Nos. 1 and 2 in ordinary condition. The strong action having taken place in Nos. 3 and 4 I shall work 5 and 6 at a lower strength in order to insure condensation. I shall thus I hope reduce Dr. Hofmann's very valuable suggestion to a rather more practical shape, and if I can by even partial success save, say, a couple of tons of nitrate of soda per week, I shall gladly renew my chambers a year sooner than would otherwise be needful.—I am, &c.,

PETER SPENCE.

Pendleton Alum Works, Manchester,  
March 21, 1870.

### ACTION OF IODINE ON HYPOSULPHITE.

*To the Editor of the Chemical News.*

SIR,—In a paper by C. R. A. Wright, published in the CHEMICAL NEWS (vol. xxi., p. 103), reference is made to a paper "*On the Estimation of Manganese*," published in the CHEMICAL NEWS (vol. xx., p. 302), in which the autolirs say:—"In estimating the manganese by the method of Bunsen, the iodine liberated by the chlorine should be tested as soon as possible after the decomposition," the iodine solutions in each of two experiments requiring an amount of hyposulphite corresponding to 62.7 per cent of available peroxide in the manganese ore assayed, when tested immediately after the decomposition, and to over 65 per cent after standing twenty-four hours. "This was caused by the conversion of iodine into hydriodic acid."

## MISCELLANEOUS.

Science in the Nineteenth Century!—The following advertisement, taken from the pages of a contemporary, is too good a joke to be lost:—"BRITISH SCIENCE having been for some time suspected of owing much of its reputation to the indifference of the general public on philosophical subjects, the truth or accuracy of which it has had no special means of acquiring practical information, or has been more or less blinded by an overweening confidence in the supposed skill of paid officials or royal Professors, several gentlemen have made it their business, at a great cost of time and labour, to investigate the grounds on which the various Astronomical and Geographical Societies have based many of their principal theories. The *assumed* convexity or curvature of the earth's surface is found to be as gross a delusion as its supposed orbital and axial motion;—That it is nothing but a stationary plane of hill and dale and level, over the face of which the sun and moon and stars revolve; that Ptolemy and the ancient Greek philosophers were the only truthful and trustworthy authorities on matters of astronomical science, and that the later theories of Galileo and Sir Isaac Newton are directly contrary to Scripture, to reason, and to the positive evidence of our senses. Those who require or are disposed to accept further particulars, are requested to communicate with —, enclosing Three Stamps, for pamphlets and postage; with lists of larger works on this subject. Literary and Philosophical Societies will do well to disabuse their minds of the impression that they can much longer resist and resent the growing demand for a thorough revision and reconstruction of their antiquated and erroneous systems."

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

*Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

*Comptes Rendus des Séances de l'Académie des Sciences*, March 14 1870.

The number contains the following original papers relating to chemistry and allied sciences:—



**Photographical Observation of the Passage of Venus, and on an Apparatus of M. Laussedat.**—M. Faye.—Owing to the general importance of this lengthy memoir, we quote the title here.

**On the Nascent State.**—H. Sainte-Claire Deville.—Continuation of a former paper on this subject, and, like the first instalment, unsuitable for any useful abstraction. There are added to this paper several tabulated forms containing the results obtained.

**General Theory of Chemical Action.**—E. J. Maumené.—A memoir on this subject was read at the meeting, but is not published.

**Experiments on the Velocity of the Propagation of Sound in Water contained in an Iron Tube of 0.8 Metre (31.496 inches) Diameter.**—F. André.—The author describes, minutely, the arrangements made for conducting his experiments, and states that, while the temperature of the water, which entirely filled the tube, was 20° at the top end of the tube and 13° at the lower, the temperature of the air being 18°, he found, as result of his experiments, that the velocity of the sound per second of time was 897.8 metres. Dr. Wertheim deduced, from his experiments with brass organ-pipes, that the velocity of propagation of sound in water was 1173 metres for the same space of time. MM. Colladon and Sturm, while experimenting on this subject on the Lake of Geneva, found the velocity 1435 metres for a second of time.

**Mechanical Properties of Steel Containing Phosphorus.**—L. Gruner.—The results arrived at by this author may be summarised as follows:—Phosphorus present in steel in a quantity of from 0.002 to 0.003 causes the metal to be rigid; it tends even to increase the elasticity and the resistance to breaking, but does not modify the hardness. Such steel, however, is wanting in real strength and toughness; it is brittle (*aigre*)—that is to say, does not withstand shocks. The general result is, therefore, that even very small quantities of phosphorus present in steel do not only not improve, but certainly deteriorate, its good qualities. Prof. Boussingault concurs in this view, and stated at the meeting that Dr. Salet, the chief assistant to Prof. Wurtz, has arranged an ingeniously-constructed apparatus to detect the smallest possible quantity of phosphorus in iron and steel, by means of the spectrum produced by the combustion of the hydrogen obtained by the action of chlorhydric acid on the metal.

*Revue des Cours Scientifiques de la France et de l'Etranger*, No. 15, March 12, 1870.

This number contains an excellent paper—

**Lecture on the Shape and Figure of our Globe.**—C. Wolf.—The contents of this paper, although not belonging to the sciences usually treated of by us, deserves the attention of all who wish to read a clear and concise account of the highly-refined scientific methods brought to bear upon the determination of the shape of the globe we inhabit. The author forgets to mention that the first measurement of a portion of a meridian arc ever made was executed very early in the seventeenth century by the celebrated mathematician, Simon Stevin, the teacher of Prince Maurice of Orange, and the inventor of carriages moved by the force of the wind, aided by sails. To Dominico Cassini is due the honour of having first suggested triangulations.

We also learn from this paper that the well-known physicist, Dr. Lallemand, has been transferred from the University of Montpellier to that of Poitiers, to fill the chair left vacant by the death of Dr. Tronessard there.

March 19, 1870.

This number does not contain any papers relating to chemistry, but we quote the titles of two excellent lectures published here, viz.:—

**On the Evolution of Scientific Medicine and its Present State.**—Dr. C. Bernard; and—

**Man of the Tertiary Period in America, and the Theory of Multiple-Centres of Creation.**—M. Hamy.

*Cosmos*, March 12, 1870.

**Modification of Fortin's Barometer.**—A. Amagat.—Instead of the movable bottom to the mercury cup of these barometers, the author displaces the mercury of the reservoir, by means of an iron or glass cylinder, which is forced down into the fluid by the aid of a screw. By this arrangement, the movable bottom (a strong skin) to the mercury cup, or reservoir, is dispensed with.

**Fresh Butchers' Meat from America to Europe.**—Herrera Yobes.—This author proposes to have the hold of vessels lined with metal (what kind of metal is not stated); the bottom of the hold is next covered with either clean straw, saw-dust, or bran, or any other suitable non-conductor of heat. Upon these, the freshly-killed and cut-up meat is placed, and on the top thereof a layer of ice, and on the top of that, again, straw or any of the other substances just named, and next, again, meat and ice, and so on; and after the hold has been thus filled, it is hermetically closed and suitably protected from the effects of hot weather during the journey from Montevideo to Europe.

**Consumption of Albumen for Industrial Purposes.**—It is a well-known fact that certain industries consume a very large quantity of albumen in some shape or other; sugar refiners, tawers, glove leather makers employ albumen in more or less pure state—in some instances the yolk of eggs only; but the calico-printers are the largest consumers, and this consumption is steadily on the increase. The

printing works of the Alsace alone consume annually more than 150,000 kilos. of dried albumen, representing rather more than 37,000,000 of eggs, or the production of 250,000 hens; add to this the consumption of the printing works of other parts of France and of other countries, and there is very little doubt that annually some 150,000,000 eggs are used for that purpose alone.

March 19, 1870.

**Amelioration of Wines by Electricity.**—Dr. Scoutetten.—As a very tangible proof of the gain obtained by the immediate conversion of young wines into drinkable beverages by means of electricity, the author states that, considering that the annual production of wine of France amounts to from 60 to 70 millions of hectolitres (each equal to rather more than 22 gals.) and that at least 10 francs per hectolitre is lost by vapourisation during the time of the maturing of the wine while in casks, this represents a number of from 600 to 700 millions of francs gained by rendering wine fit for immediate consumption by the author's electric process. We may, not inaptly apply here—"Si non e vero e bene trovato."

**Meteorite Observed at Alicante, Spain.**—C. Miallejde.—The author states that, just about sunset on the 2nd inst., he observed, while walking on the pier (the town is situated on the Mediterranean), a meteorite, much akin in size, colour, and shape to, but far larger than, the planet Jupiter, moving with great speed from east to west.

**Artificial Butter.**—Dr. Mège.—When the stearic acid employed for making the so-called stearine candles, is strongly pressed (as is always done in its manufacture, to get rid of the oleic acid), an oily substance is obtained which, according to this author, is identical in composition with butter, but fluid. The author submits this material to several processes of infusion, decolouration, and beating (a kind of churning), and at last converts it, also, in physical appearance, into butter. The editor of this paper very properly adds that the Cossacks understand this matter far better, and with less ample machinery, since they, it is well known, are in the habit of converting oils readily into an unctuous substance by a simple process. The rationale, in both cases, is a partial saponification.

*Journal für Praktische Chemie*, No. 21, 1869.

This periodical contains the following original papers and memoirs:—

**On Benzoic Acid and Gum Benzoin.**—Julius Löwe.—The contents of this paper are the answers given to four queries, viz.:—(1) Does benzoic acid pre-exist in gum-benzoin ready-formed and in free state? (2) Is the benzoic acid present in the resin combined with a base? (3) Is benzoic acid a product of the oxidation of a part of the resin formed by the taking up of oxygen during the melting of the resin? (4) Is benzoic acid a product of a portion of the resin formed by the heat of the fusion of that substance? The author's experiments, detailed at great length, commenced with the finding of a reply to No. 3, and the result is a negative—viz., that when the process of sublimation (as usually employed for obtaining benzoic acid from gum benzoin) is carried on in atmospheres of hydrogen or carbonic acid gas, the quantity and quality of the acid obtained are the same as when the process is carried on in contact with air. As regards the replies to Nos. 1, 2, and 4, a series of experiments made in various ways proved, undoubtedly, the pre-existence of ready-formed benzoic acid in the resin. The last portion of this paper is devoted to the very minutely-detailed description of the best practical method of the preparation of benzoic acid from the resin.

**Composition of Soda and Lime Felspar.**—G. Tschermak.—Since some doubt had arisen concerning the proper place to be assigned, in chemical mineralogy, to the minerals just named, the author made analyses of carefully-selected minerals, with the following results for 100 parts:—Silica, 48.94 and 49.40; alumina, 33.26 and 32.60; lime, 15.10 and 15.05; soda, 3.30 and 2.95. The second numbers refer to and prove these felspars to be mixtures of 75 per cent of anorthite and 25 per cent of albite. The sp. gr. of the samples was, respectively, 2.729 and 2.723.

**On the Haloid Compounds and their Derivatives Corresponding to Picric Acid and Dinitro-Phenol.**—Conrad Clemm.—(Preliminary notice.) After briefly referring to Pisani's labours on this subject, the author says that the chloro-trinitro-benzol, obtained by causing pentachloride of phosphorus to act upon picric acid, is converted, by the action of ammonia and aniline, into trinitraniline and trinitro-diphenylamine, which latter substance yields, with sulphocyanide of potassium, a body,  $C_{14}H_{11}N_6SO_{12}$ . Chloro-dinitro-benzol has been prepared by the author from dinitro-phenol, as well as from chlorobenzol; both products are identical, and fuse about between 48° and 50°. By means of these compounds, it is possible readily to prepare from benzol, phenol derivatives. Dinitraniline has been prepared by the author by means of bi-nitrated bromobenzol, as, also, by means of chloro-dinitro-benzol; both products are identical, and their melting-point is 175°. Aniline and bromo-dinitro-benzol yield dinitro-diphenylamine, fusing at 153°. These researches will be continued, and the action of pure solid fused phenol upon sulphocyanide of potassium and upon sulphate of diazo-benzol will be investigated fully.

*Bulletin de la Société d'Encouragement pour l'Industrie Nationale* No. 205, January, 1870.

This number does not contain any original papers relating to chemistry, but we meet here with a very extensive report, accompanied by several engravings, on—



Electric Clockwork and Machinery for Striking Hours and Quarters by means of Electric Action, as Executed by M. Fournier and Reported on by O. Tresca.

*Moniteur Scientifique*, No. 318, March 15, 1870.

This number contains the following original papers relating to chemistry and allied sciences:—

**Quantitative Estimation of Sugar.**—Georges Ville.—This paper, too lengthy for any useful abstraction, is divided into the following sections:—Apparatus required, illustrated by woodcuts; reagents; estimation of total quantity of sugar; estimation of glucose; calculation of results; estimation of sugar in vegetable tissues; estimation of sugar in vegetable juices; tabulated form to assist in the calculations.

**Determination of the Commercial Value of Bleaching-Powder and Manganese.**—G. Tissandier.

**Some Experiments with Salts of Chromium.**—A. Commaillie.—This lengthy paper contains the following sections:—Nitric acid and bichromate of potassa; sulphuric acid and bichromate of potassa; chlorhydric acid and bichromate of potassa; iodic acid and bichromate of potassa; oxalic acid and bichromate of potassa; acetic acid and bichromate of potassa; tartaric acid and bichromate of potassa; citric acid and the same salt; tannic acid and the bichromate alluded to; and, lastly, benzoic acid and the same salt.

**Chemical Dance: Instantaneous Apparition of Aniline Colours.**—Under this title, a somewhat verbose, but, after all, elegantly-described curiosity, is related as follows:—Some few weeks ago, Madame A. W. Hofmann gave a grand entertainment and ball to the large number of her eminent husband's pupils. In the ball-room were placed, on the table, a large number of bouquets of flowers (artificial, of course), all snow-white, and close by, on the same table, a large number of pieces of beautifully-white silk ribbon; at the other end of the room a fountain was arranged, throwing, from narrow openings, jets of exquisitely-perfumed eau de Cologne. The bouquets were taken by the ladies, and the ribbons by the gentlemen; and, while waltzing together, and thus arriving at the end of the room where the fountain played, the ladies, holding their bouquets to be sprinkled over with the perfume, beheld the white flowers become suddenly beautifully red, violet, blue, yellow, and green-coloured, while the ribbons carried by the gentlemen assumed, under the same influence, similar colours. The secret of this trick is simply that the objects alluded to had been very gently dusted over with the dry powders of variously-prepared aniline colours, and, on becoming moistened by the eau de Cologne (alcohol), these powders became dissolved, and imparted colours to the objects.

*Bulletin Mensuel de la Société Chimique de Paris*, February, 1870.

From the *procès verbaux* of the meetings of this Society held in the month of January last, we learn, in the first place, that Ch. Friedel is the president of the Society for the present year, and MM. J. Bouis and E. Willm, secretaries. M. Terreil made a communication on the progress of his researches on the—

**Treatment of Minerals by Saline Solutions.**—(More especially alluding to the action of alkaline sulphides on native metallic sulphides.) Sulphide of antimony is readily dissolved; realgar (arsenical sulphide) is only incompletely dissolved; while the sulphides of tin and molybdenum (native) are not at all acted upon. Native sulphide of nickel and the white-coloured iron pyrites (mundic), also the magnetic pyrites, are slowly dissolved; but the yellow-coloured variety (coal brasses) is not acted upon. All minerals which contain sulphides of arsenic and antimony, as, for instance, ruby silver ore (grey antimony ore), are decomposed by alkaline sulphides; but mispickel, for instance, which is a metallic arsenide combined with sulphur, is not attacked by these solvents. Mispickel is an arsenical pyrites, containing iron, arsenic, and sulphur.

The President of the Society stated that he had been engaged with Dr. Ladenburg in researches on the—

**Products of the Oxidation of Acetone.**—Among these, mesoxalic acid has been found.

Dr. Wurtz spoke on the—

**Synthesis of Organic Acids which can be obtained by Starting from Chlorinated Hydrocarbons by the Action of Chloroxycarbonic Ether in the Presence of Sodium.**—Bromide of benzyle, treated with chloroxycarbonic ether and sodium amalgam, yields, with proper precautions, a complex crystallisable acid,  $C_{15}H_{14}O_2$ , dibenzyl-carboxylic acid, resulting from the action of one molecule of chloroxycarbonic ether upon two molecules of chloride of benzyl. The lime-salt of this acid yields, when submitted to destructive distillation, two hydrocarbons—viz., dibenzyle,  $C_{14}H_{14}$ ; and stilben,  $C_{14}H_{12}$ .

The following papers were read:—

**Chemical Equilibrium Existing between Carbon, Hydrogen, and Oxygen.**—M. Berthelot.—This lengthy paper, which contains, also, the history of the earliest researches on the action of electricity upon gaseous compounds, is divided into the following sections:—Decomposition of carbonic acid; decomposition of aqueous vapour and steam; equilibrium between hydrogen, oxygen, and carbon; action of electric sparks upon mixtures of gases.

**Spectra Exhibited by some Compound Bodies Present in Mixtures in the State of Equilibrium.**—Dr. Berthelot and J. Richard.

**Bromo-Toluen and Pseudo-Toluidine.**—A. Rosenstiehl.—This paper is a very lengthy and sharply-critical reply to M. Wallach, who published an article under the above heading in the January number of this periodical.

*Revue Hebdomadaire de Chimie*, March 10, 1870.

**Apparatus for the Evaporation of Beet-Root Juice, designated as à Triple Effet.**—M. Schreiber.—A description of a very useful contrivance for the utilisation of waste steam for the purpose of evaporating the juice while circulating, so as to obviate, as much as possible, the formation of calcareous deposits from the juice against the sides of the evaporating pan.

**Volumetrical Assay of the Iodine of Commerce.**—A. Bobierre. An aqueous solution of iodide of potassium of known strength is made and kept invariable for a number of assays; this solution being destined to dissolve the iodine to be tested. Next, a solution (normal) of arsenite of soda is made, by dissolving, in a litre of water, 4.95 grms. of arsenious acid and 14.5 grms. of crystallised carbonate of soda (pure); this liquid completely decomposes any iodine containing liquid, the quantity of that haloid amounting to 12.688 grms. to the litre. A solution of bicarbonate of soda in cold water is made, rather concentrated, to be used as will be indicated presently. Take a small glass-stoppered bottle; pour into it 10 c.c. of the arsenite of soda solution and 5 c.c. of the bicarbonate of soda solution, and next 4 c.c. of benzol. Weigh off any quantity of a sample of pure iodine; dissolve it in a quantity of the above-mentioned solution of iodide of potassium, fill with this solution, which is, of course, brown-coloured, a bottle of 100 c.c. capacity. Shake the bottle containing the liquid, and pour, *guttatim*, into a graduated burette; the brown colour will disappear, the benzol becomes rose-coloured, and the aqueous liquid yellowish. It is clear that a second assay, made with the same quantity, by weight, as the first, but of the iodine to be tested, will give as result the richness of the sample in iodine, because the bulk of the solution required for the decomposition of the alkaline arsenite is inversely proportioned to the real quantity of iodine sought for.

**Process of Sugar Manufacture.**—M. Mueseler.—This process is based upon capillary action, but the description here given is too vague to give any adequate idea of its practical applicability.

**Testing of Alcohol and Spirits for Amylic Alcohol.**—Since the internal use of amylic alcohol, even in small quantity, is very deleterious, the means of rapidly testing for its presence in spirits and alcohol (either for pharmaceutical or scientific use) is of importance. The suspected alcohol is poured into a burette, mixed with its own bulk of rectified and pure ether, and also its own bulk of water, and the mixture gently shaken; the ether, on becoming separated from the rest of the fluid, floats to the top, containing in solution the whole of the amylic alcohol which might have been contained in the alcohol or spirits under examination. The ether is removed by a pipette, and on leaving it to spontaneous evaporation, will leave behind the amylic alcohol, readily detected by its offensive smell.

**Description of a Newly-Invented Apparatus for Preparing Animal Charcoal.**—MM. Guilbert, at Eth (Dep. du Nord).—Accompanied by woodcuts.

**Preparation of Neutral Perchloride of Iron.**—M. Bouilhon.—This process may be summarised as follows:—Dissolving of iron in dilute hydrochloric acid, aided by heat; evaporation of the solution obtained, and crystallisation; solution of the crystals in distilled and previously well-boiled water, cooled without contact of air; passing a slow current of chlorine through this solution while in rather concentrated state.

**Preparation of Caffic Acid.**—J. Hlasiwetz.—Take of extract of coffee (raw or green), 50 grms.; dissolve in 120 c.c. of tepid water; add 50 grms. of caustic potassa. Boil this mixture for an hour in a large retort provided with a condenser; saturate the potassa with sulphuric acid; shake the mixture three times with fresh quantities of ether; remove that liquid by distillation, when crude caffic acid is left, which is dissolved in water and purified, by means of animal charcoal. From the above-quoted quantity, 6 grms. of the pure acid are obtained.

**Estimation of Bromide of Potassium Mixed with Chloride.**

—Dr. Baudrimont.—Test the sample qualitatively, first, for carbonate and the presence of iodide, since especially the latter renders the bromide unfit for medicinal use, and its presence would also interfere with the process of analysis to be described. (It should be remembered that 1 grm. of bromide of potassium requires for precipitation exactly 1.428 grms. of nitrate of silver, and that 1 grm. of chloride requires exactly 2.278 grms. of the same nitrate for the same effect). Dissolve 1 grm. of the suspected bromide in 100 c.c. of distilled water; take 10 c.c. of this solution, which precipitate completely, by a solution of nitrate of silver *au centième* (1 part in 100 of water), poured out of a burette graduated so as to be enabled to read off tenths of c.c. If the bromide is pure, 142 of the divisions of the burette filled with the nitrate of silver solution will be required; if the salt contains chloride, more of that solution will be required; and, since the perfectly pure chloride would require 227 divisions, it is readily found by calculation what amount of chloride the bromide contains.

**Adulteration of Sub-Nitrate of Bismuth.**—This salt has been of late frequently sophisticated with phosphate of lime (bone-ash). To detect this, the salt in question may be dissolved in nitric acid, and this solution precipitated by carbonate of potassa solution. If the bismuth-salt is pure, it is re-dissolved in excess of that precipitant; but any phosphate of lime present is not rendered soluble by this reagent. Of course others sophistications may exist, and therefore proper tests have to be applied to ascertain the nature of the substance.



*Les Mondes*, March 17, 1870.

Imperial Society of Sciences at Lille (Nord, France).—Prize of 1000 francs (£40) for the best work on any of the subjects of experimental natural philosophy on which hitherto no monograph has been published (by this Society?); June 1st, 1870. Same-valued prize for a work on clinical thermometry; October 1st, 1872. Gold, silver-gilt, silver, or bronze medals for—An elementary work for schools, on the mechanical theory of heat, and its applications to machinery; researches concerning the different qualities of butcher's meat, with proper elucidation of the cause why inferior qualities of meat are less nutritive, for the same weight, than better ones; description of the simplest means of obtaining proper ventilation in cafés, estaminets, and other rooms, by the aid of the ordinary methods of lighting and heating; renewed study of the chemistry of sugar manufacture (beet-root); renewed study of colouring matters; renewed study on bleaching materials. We have left out all questions belonging to physiology and natural history, as well as those of local importance only.

Pneumodensimeter.—A. de Negro.—Description, illustrated with several engravings, of very great and important improvements effected in Bunsen's apparatus for the estimation of the specific gravity of gases, by determining the duration of their flow through very narrow openings, or through very thin plates. The apparatus, as described, is self-registering.

*American Journal of Pharmacy*, March, 1870.

Contains the following original papers relating to chemistry and allied sciences:—

Notice of M. Carré's Apparatus for Ice-Making.—W. Procter. It appears from this paper that this invention, wherein ammonia gas liquefied by pressure is applied, is a decided success.

Reaction between Spirit of Nitrous Ether and Bicarbonate of Potassa.—Dr. Rademaker.—The author states that, while keeping sweet spirits of nitre, prepared according to the U. S. P., in a bottle containing, as advised, bicarbonate of potassa in crystals, he observed these crystals change form. On examining the same, and applying tests, he found that nitrite of potassa had been formed, while the liquid which had been prepared with great care, was neutral to begin with and had remained so; no perceptible solution had taken place. Aqueous solution of bicarbonate of potassa readily decomposes the fluid in question.

Assay of a Pure American Opium.—W. Procter, jun.—In 100 parts, this sample, obtained from plants grown from foreign seed, contained—Morphia, 15.75; impure narcotine, 2.0; meconic acid, 5.25; caoutchouc, fatty matter, and resin, 11.00; residue insoluble in benzol (including 0.5 ash), 22.0; matter soluble in water, other than salts of morphia and narcotine (as gum, extractive, &c.), 38.5; water, 5.0. No attempt was made to isolate codeia, narceia, meconine, and the like.

On Sulpho-Carboic Acid and Sulpho-Carbolates.—W. Procter, jun.—Too lengthy for useful abstraction. An excellent paper for perusal for good methods of preparation of these substances.

Zinc Sulpho-Phenate.—Dr. Hagar.—A lengthy paper on the preparation of this salt for pharmaceutical use.

Solution of Citrate of Magnesia.—B. Rother.—This paper contains an excellent review of the various salts citric acid and magnesia yield, and a good formula for the preparation of a pharmaceutically-useful solution of a citrate of magnesia, soda, and potassa.

This number contains, in addition to the papers alluded to, several good papers of purely pharmaceutical importance.

## NOTES AND QUERIES.

Liq. Ammonia.—How and what kind of apparatus is used for making Liq. Ammon. Fort. (880), as I want to use some of that strength daily, to make about 2 cwts. of it at once?—J. SPENCER.

Baumé's Hydrometer.—How may I gain a knowledge of the comparison which the common specific gravity glass bears to Baumé's hydrometer and specific gravity glass?—J. T. E.

Alumina.—Can any of your readers tell me whether pure alumina is to be obtained from any source? I have heard that it exists somewhere in Cornwall under the name of "Wavellite," but I can learn no more.—ARTHUR WARNER.

Basic-Salt of Iron.—When a solution of  $\text{FeSO}_4$  is exposed to the air until no further change occurs, what is the formula of the basic-salt precipitated, and of the acid-salt remaining in solution?—FERROUS SULPHATE.

Dr. Schiebler's Apparatus.—I see that mention is made by Mr. Arnot, in his articles on "Sugar Refining," of Dr. Schiebler's apparatus for the amount of carbonates. I cannot find any description of it in the last edition of Fresenius nor in Griffin's "Chemical Handicraft." Can he give me some idea of the instrument, its price, where procurable, and if applicable for the amount of mineral carbonates?—W. R.

Dissolving Cellulose, &c.—(1) Are there any special conditions required, so that cellulose may dissolve in the ammonia solution of copper, or silk in chloride of zinc? (I kept the latter at about 100° F.) (2). Are there any other solvents easily separated from the colloid, suitable for making the latter give a tenacious film? (The film is required transparent, tough, insoluble in water and unaffected by

moderate heat, conditions which the enclosed specimen possesses, but for the objections in its preparation and the expense). (3) Can you give me a cheap method of destroying the smell of methylated spirit? (4) Is there any substance that will render gelatine insoluble in clear, transparent sheets besides the bichromates of ammonia and potash and alum?—BICHROMATE.

## MEETINGS FOR THE WEEK.

MONDAY, 28th.—Medical, 8.  
— London Institution, 4.  
— Geographical, 8.30.  
TUESDAY, 29th.—Royal Institution, 3. Prof. Rolleston, on "Nervous System."  
— Institution of Civil Engineers, 8.  
WEDNESDAY, 30th.—Society of Arts, 8.  
— Ethnological, 8.  
THURSDAY, 31st.—Royal Institution, 3. Prof. Odling, "Chemistry of Vegetable Products."  
— London Institution, 7.30.  
— Royal, 8.30.  
— Philosophical Club, 6.  
FRIDAY, April 1st.—Royal Institution, 8. Prof. Roscoe, "Artificial Alizarine."  
— Geologist's Association, 8.  
SATURDAY, 2nd.—Royal Institution, 3. Mr. Lockyer, "The Sun."

## TO CORRESPONDENTS.

\* \* Vol. XX. of THE CHEMICAL NEWS, containing a copious index, is now ready, price 11s. 4d., by post, 11s. 10d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our office, or, if accompanied by a cloth case, for 1s. Subscribers wishing to complete their sets of volumes are requested to apply to the publisher, who will give them information respecting scarce numbers and volumes. Vol. xxi. commenced on January 7th, and will be complete in twenty-six numbers.

The report of the Chemical Section of the Glasgow Philosophical Society arrived too late for insertion in this week's number.

B. Silliman.—Received with thanks.

Metallurgis.—Copper should be perfectly pure; any alloy injures its conductivity.

Prof. C. F. Chandler.—Received with thanks.

## BOOKS RECEIVED.

Midland Steam Boiler Inspection and Assurance Company. Chief Engineer's Report, with Records of Boiler Explosions, 1869.

Catalogue of Chemical Manufacturers' Machinery, Plant, &c., as made by Robert Daglish and Co., St. Helen's Foundry, Lancashire. 1870. Red cloth.

The Week of Creation, or the Cosmogony of Genesis considered in its Relation to Modern Science. By George Warington. London: Macmillan and Co.

The Fuel of the Sun. By W. Mattieu Williams, F.C.S. London: Simpkin, Marshall, and Co.

Now ready, price 6d.,

Notes from the Laboratory of a Sugar Refinery. By WILLIAM ARNOT, F.C.S. Reprinted from the CHEMICAL NEWS.

London: CHEMICAL NEWS Office, Boy Court, Ludgate Hill, E.C.

## PRACTICAL CHEMISTRY.

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Attractive Novelties.—Professor Pepper's Lecture Entertainment, "On the last New and Wonderful Ghost Effects, and other Optical resources of the Polytechnic."—The Romantic Tale of "Rip Van Winkle," with extraordinary Dioramic and Spectral Scenes. The Story narrated by Mr. Ward. Vocalist, Miss Pearson; and the New Music by Mr. Frewin, Herr Schalkenbach, and Band.—American Organ Daily.—Professor Pepper's Annual Course "On Astronomy and Spectrum Analysis," Wednesdays at 2.30, and Saturdays at 3, during Lent, at the ROYAL POLYTECHNIC. Open from 12 to 5, and 7 till 10. Admission to the whole, 1s.



# THE CHEMICAL NEWS.

VOL. XXI. No. 540.

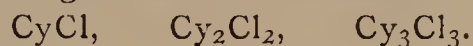
## CONCERNING ATOM-FIXING AND ATOM-DISPLACING POWERS.\*

By WALTER NOEL HARTLEY, F.C.S.

### PART II.

It is very evident that the secondary atom-fixing powers of nitrogen enter into combination more frequently—that is to say, they are more powerful than the extraordinary atom-fixing powers of chlorine, bromine, and iodine; and as the secondary powers in the nitrogen are those which give trivalent functions to cyanogen, we see why the number and variety of the double cyanides is so extensive—in other words, why cyanogen is more eminently trivalent than the radicles with which it is classed.

Polymerism is the most remarkable feature of cyanogen compounds; the most notable case is that of the three chlorides of cyanogen. Although the existence of the second is somewhat doubtful, still there is a possibility of such a body being obtained.

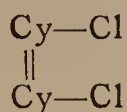


There are at least two ways in which the formulæ for these combinations may be expressed, *e.g.*, either—

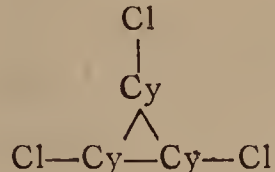
I.



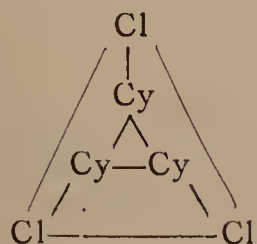
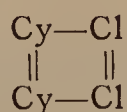
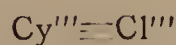
II.



III.



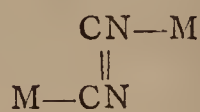
or—



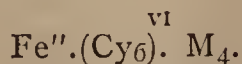
In the one case, we have only the ordinary atom-fixing powers of the Cl exerted; but, in the second example, the chlorines are combined with each other by virtue of their triad functions.

Here follow a few cyanogen combinations, formulated in consideration of the triadic character of cyanogen.

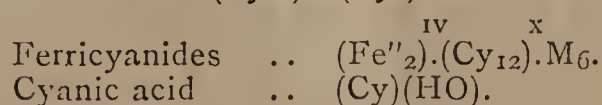
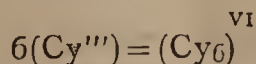
Simple cyanides showing their power of combining with other cyanides—



Ferrocyanides—

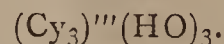


According to the general formula before mentioned, relating to the combination of multivalent radicles to form a multivalent molecule—



This body admits of polymerism, for the HO here functions in place of Cl in the primary cyanogen chloride; we

may accordingly look for the hydroxyl analogue of  $\text{Cy}_3\text{Cl}_3$ : this we find in cyanuric acid—

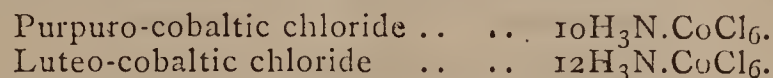


Amides—

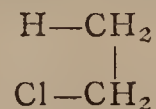


The tertiary amide is melamine,  $(\text{Cy}_3)'''(\text{H}_2\text{N})_3$ .

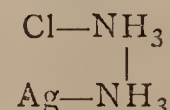
Tricyanamide,  $(\text{Cy}_2\text{N})'''(\text{CN})'''$ , which may be regarded as  $(\text{H}_2\text{N})(\text{CN})$ , in which  $\text{Cy}_2$  replaces  $\text{H}_2$ , or as  $\text{NCl}_3$ , in which Cy acts in place of Cl, is an unknown substance, and it is scarcely likely that it exists, considering the instability of the chlorides and iodides of nitrogen, to which it would correspond. The cyanide of ammonium is a body of much less stability than the iodide; tricyanamide may, therefore, be expected to be still more changeable than even chloride or iodide of nitrogen. A class of interesting and complicated ammonia compounds are the cobaltamines, such as, for instance—



These have already been considered by Odling\*, who offers a theory of their constitution. Taking  $\text{CH}_2''$  as the analogue of  $\text{NH}_3''$ , the various multiples of ammonia in these complicated molecules are regarded as resembling the multiples of  $\text{CH}_2$  in the alcohol radicles; if, then, chloride of ethyl be written—



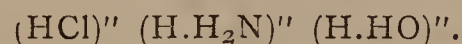
ammonic chloride of silver may be expressed thus:—



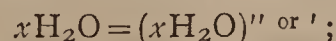
Such is the briefest way of stating these views: an extension of them explains more complex ammoniated molecules.

There exists a very large class of substances concerning the nature of which nothing definite in the way of explanation has been offered—I mean the crystalline hydrates.

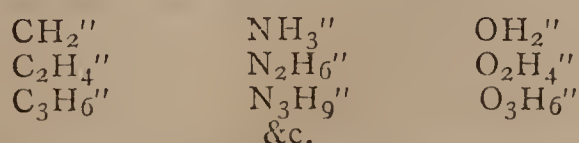
In classing hydrogen with those metals and other elements having a somewhat marked triadic character, it cannot be made an exception to the law which regulates them; therefore, if the law of Canizzaro and regular atomic displacing power are bases of any value for the classification of bodies, I am of opinion that hydrogen has the same atom-fixing power as chlorine and iodine, &c. Let us regard hydrogen as  $\text{H}'''$ ; then hydroxyl, which, we find, functions as  $\text{Cl}'''$  or  $(\text{H}_2\text{N})'''$ , will assume the quantivalence represented by  $(\text{HO})'''$ . The combinations of these radicles with hydrogen then produce—



Observe the case of the bivalent carbon compound,  $(\text{CH}_2)''$ ; this undergoes repeated condensations, to form more complex molecules which still remain bivalent. Again,  $(\text{H}_3\text{N})''$  behaves in a strictly similar manner; and this, too, we find to be precisely the case with water. Thus, by polymerism we may obtain—

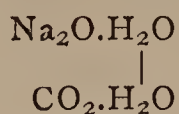
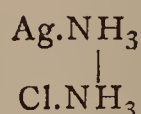
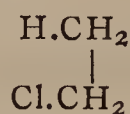


that is to say, any number of molecules of water may be combined to form a molecule with a full combining power equal to 2. It follows, naturally, that we may have sodium carbonate crystallising with 1, 2, 3, 4, 5, 6, 7, 8, 9, or 10 molecules of water. We have three parallels in the hydrocarbons, the ammoniated salts and the hydrates—

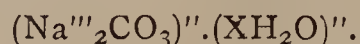


\* On page 109, the line referring to the doubtful  $\text{NO}''\text{Cl}_2$  and the non-existent  $\text{PO}''\text{Cl}_2$  was, in my rough notes, cut out by a pencil-stroke, but, being inadvertently copied, passed into print.



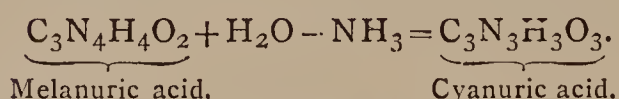
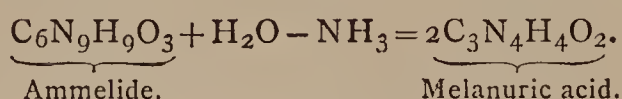
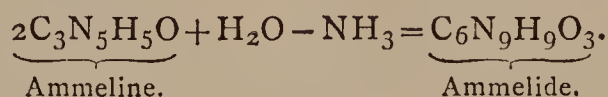
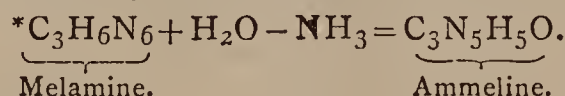


The various sodium carbonates may thus be generally expressed,  $x$  being equal to any whole number not exceeding 10:—

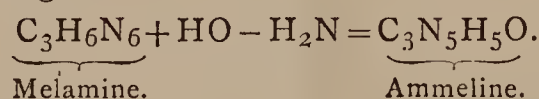


Sodium borate .. .. .  $(\text{NaHBrO}_4)'''.(\text{H}_{18}\text{O}_9)''.$   
Magnesium sulphate .. .. .  $(\text{MgSO}_4)'''.(\text{H}_{12}\text{O}_6)''.$   
Crystalline chlorine hydrate ..  $(\text{Cl}_2)'''.(\text{H}_{20}\text{O}_{10})''.$

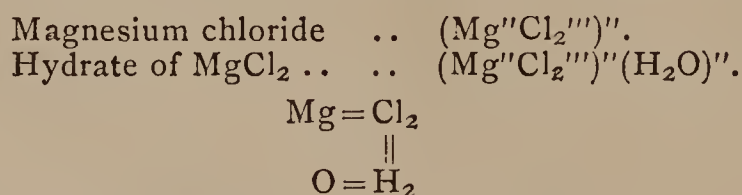
Now there is a further resemblance between ammonia and water, than that of condensing to form complex molecules—the one may be substituted for the other; not a better illustration of this displacement of  $\text{NH}_3$  by  $\text{H}_2\text{O}$  can be brought forward than the equations expressing the passage of melamine into cyanuric acid:—



Perhaps the more exact statement would be to say that hydroxyl displaced amidogen, which, however, comes to the same thing—



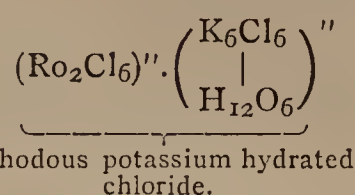
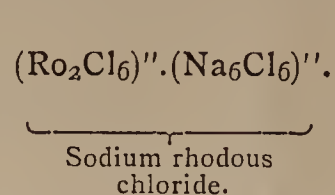
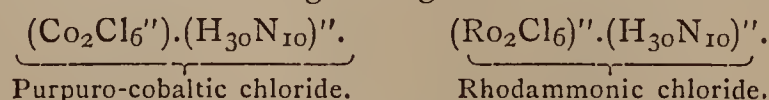
Anhydrous chloride of magnesium is very difficult to obtain, on account of its very greedy absorption of water. This water cannot be driven off by heat; the action of heat expels  $\text{HCl}$  and leaves  $\text{MgO}$ . The reason of this is quite obvious, if we suppose the hydrogen of the water, and the chlorine of the magnesium chloride, to be triadic, for in that case they can combine with each other; and the hydrate of magnesium chloride is then an intelligible compound, giving an intelligible decomposition when heated. For instance—



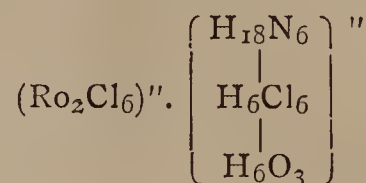
When heated,  $\text{MgO} + 2\text{HCl}$ .

The chlorides of the dyad metals generally have a tendency to unite their chlorine to the hydrogen of  $\text{H}_2\text{O}$ ; and hence the remarkable avidity with which chloride of zinc and chloride of calcium seize upon water. The chlorides of aluminium and iron have the same property, the former most markedly, and give, more or less completely, the same decomposition when heated; chloride of calcium disengages a portion of its  $\text{Cl}$  as  $\text{HCl}$  at a high temperature.

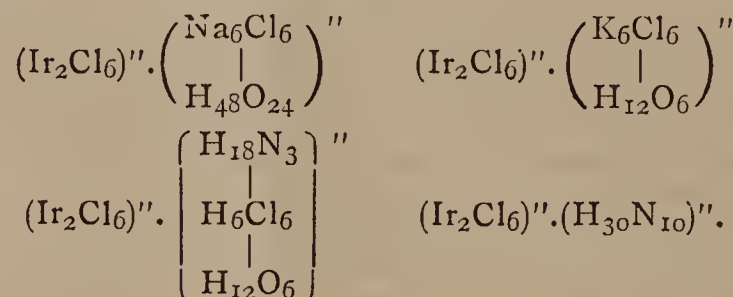
There is, of course, a possibility of other similarly-constituted bodies acting as bivalent radicles, and uniting to form a molecule without alteration of combining power; thus, chloride of sodium or potassium may play the same part as  $\text{HCl}$  in sal ammoniac and  $\text{NH}_3$  in ammoniated compounds. We do, indeed, possess substances in which  $\text{KCl}$  and  $\text{NaCl}$  have this rôle allotted them; for instance, there exist the following analogous substances:—



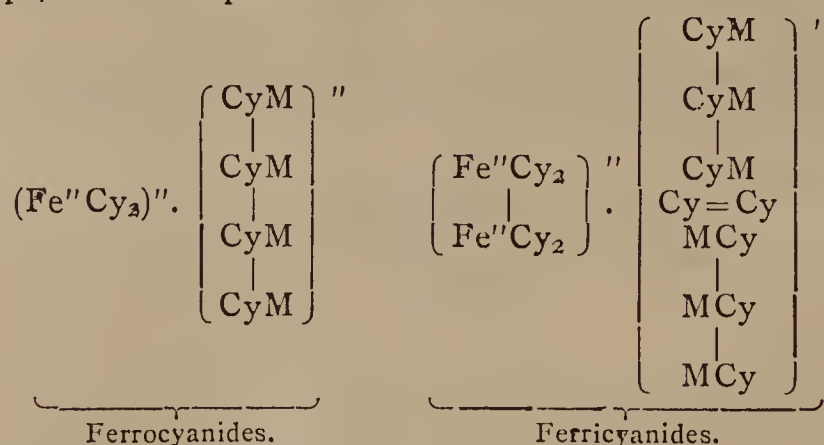
We have a further example of water, ammonia, and hydrochloric acid, all in the same molecule, united to  $\text{Ro}_2\text{Cl}_6$ , e.g.—



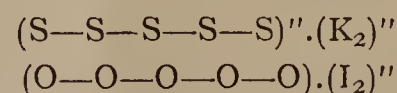
Similar iridium compounds exist, for instance—



All these bodies, then, have the radicles,  $\text{H}_3\text{N}$ ,  $\text{H}_2\text{O}$ ,  $\text{HCl}$ ,  $\text{KCl}$ , and  $\text{NaCl}$  condensed in the same manner as  $\text{CH}_2$  in the olefines, or alcohol radicles, &c. Certain cyanogen compounds have a similar construction; for example, the ferrocyanides and ferricyanides may, perhaps, be thus represented—



I consider that such molecular condensations are not confined to compound bodies; the dyad elements, for instance, in potassium-pentasulphide and iodic and periodic anhydrides have a like behaviour, thus:—

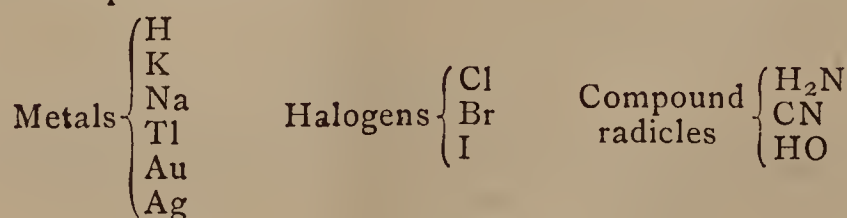


The triads, likewise, as exemplified in the methylium periodides—



From the consideration of these complex combinations, I am led to classify the monad radicles in the following manner:—

With powers I. and III.—



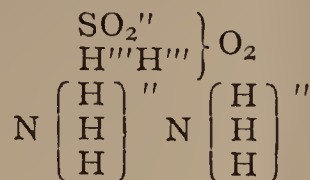
These bodies having monad and triad characters, resemble, as a class, nitrogen and its congeners, inasmuch as they have two weaker atom-fixing powers.

It may be objected from what I have said concerning the triad nature of hydrogen, that we should expect ammonia to be a saturated molecule, and also that the ammonium-oxygen salts should undergo a similar decomposition to that of the haloid salts; for instance, taking ammonium sulphate, it might be supposed that the two free

\* Kekulé. ("Lehrbuch der Organischen Chemie," vol. i., p. 359).



powers of the hydrogens in  $\text{H}_2\text{SO}_4$  saturate the two free powers of the nitrogens in the ammonia molecules.



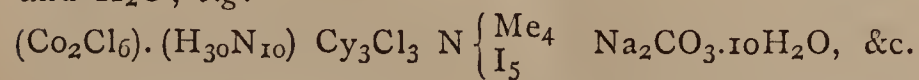
This is, however, not the case; as then we should have five hydrogen atoms united to each nitrogen, a combination which has not yet been effected; and, furthermore, we should be assigning to hydrogen the same intensity of atom-fixing power as Cl, Br, and I. We should thus be overlooking the fact that, in the nitrogen series, those elements with the higher atomic weights are those more powerfully pentadic. (It is true that we have no pentachloride of arsenic or bismuth; but this goes for little against the other evidence of pentad character, when we consider that no terhydride of bismuth exists, yet we have a terethide.) The power of fixing five atoms increases with the atomic weight. In the hydrogen family the same thing is obvious; Au, Tl, and I are more powerfully triadic—they, too, are the elements with the higher atomic weights; consequently we should look for a less-markedly triadic character the lower the atomic weight; much less, therefore, should we expect an element with the lowest atomic weight to have so decided a power of fixing three atoms. The reason why we have not a tertiary hydrocyanic acid is on account of the comparatively feeble atom-fixing powers of hydrogen; but we have a compound tending in that direction. Thus, by passing chlorine into HCN, Wurtz obtained this substance—



or cyanogen trichloride with one Cl replaced by H.

That the atom-fixing powers of hydrogen are feeble, in comparison with those of chlorine and iodine, is shown by the extreme facility with which the carbonate of sodium,  $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$ , under very trifling changes of temperature, and other causes, loses one or more of its molecules of water.

Again, it may be objected that, if H has a triad power, it is less likely to combine with itself than with any other element. I would, to this, answer, no; it appears to me, on the contrary, the extraordinary atom-fixing powers are the true cause of the polymerisation of N, Cy, Cl, I, and  $\text{H}_2\text{O}$ ; e.g.—

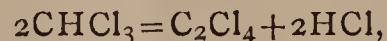


In Watts's "Dictionary," it is stated that Kekulé has treated of many of the substances I have mentioned as as molecular compounds, combinations resembling the crystalline hydrates. No definition of the constitution of these bodies is given; but we are told they arise from a juxtaposition of molecules. I will quote, however, a statement from one of Kekulé's publications (*Ann. der Chem. und Pharm.*, vol. civ., p. 133)—"A combination of several molecules belonging to the types,  $\text{HClHCl}$ ,  $\text{H}_2\text{OH}_2\text{O}$ ,  $\text{HClH}_2\text{O}$ , can only take place if, by the entrance of a polyatomicradicle in the place of two or three atoms of hydrogen, a cause of union occurs." This amounts to saying that the crystalline hydrates are not combinations. Now this juxtaposition of molecules must be either a combination of molecules or not; if it be not a combination of molecules, then the resulting body is not a chemical compound, but is such a juxtaposition of molecules as we generally understand by a mixture of liquids or gases bearing no hitherto recognised relation to the atomic weights. On the other hand, if it be a combination of molecules, it is evident the molecules are not previously-saturated compounds, otherwise they would have no combining power, and consequently would not combine; for the combining power of a molecule is dependent on the non-saturated condition of one or more

of its constituent atoms. Regarding a combination of  $\text{SO}_3$  and  $\text{KCl}$ , Williamson\* makes a similar statement, to the effect that neither the chlorine nor potassium are other than monad elements—they are combined to saturation; yet the two molecules,  $\text{SO}_3$  and  $\text{KCl}$ , are held together by chemical force. Are we to have two kinds of chemical force, one holding together K and Cl, the other uniting  $\text{SO}_3$  and  $\text{KCl}$ , or is it only a matter of degree of force exerted, which makes one class of compounds differ from another? I have endeavoured to show that the latter alternative is what I am induced to believe correct.

Somewhat in accordance with what is suggested in this paper are the results communicated to the Chemical Society by Dr. Gladstone, "On Refraction Equivalents."† Some of the elements have a double refraction value, "and this peculiarity is, in most cases, coincident with a change of atomicity. Thus iron, in the ferrous salts, has the equivalent 12.0, in the ferric salt, 20.1; and, since the refraction equivalent of iron in potassic ferridcyanide is 11.7, the view suggests itself that the metal is here in the same condition as in the ferrous salts."

My formula given above for ferricyanides is in harmony with this. But amongst those elements with a double value, we find Cl, Br, I, and H; it is not improbable that behind this is lurking the evidence of the truth of my suggestions regarding monad elements. Furthermore, Dr. Gladstone mentioned that  $\text{NH}_4\text{Cl}$  gave numbers equivalent to  $\text{NH}_3$  and  $\text{HCl}$ , which is to be expected if the true constitution be  $\text{NH}_3'' \cdot \text{HCl}$ , but not otherwise. The same results may be looked for with  $\text{PCl}_3 \cdot \text{Cl}_2$  and  $\text{SbCl}_3 \cdot \text{Cl}_2$ ; for it stands to reason that these bodies do not demonstrate the usual decomposition of chlorides by heat, else we should have the following equation verified:—



a change which the author at one time thought possible, and vainly endeavoured, after repeated trials, to effect. What really takes place is thus represented:—



I should have preferred to have further developed these views, to have sought longer for proofs of their correctness, and placed them in a more carefully-stated form, but I am induced to give them publicity in their crude state, on account of my belief that a tendency of thought towards the same point is rife at the present time in the minds of others. To give an impetus, therefore, to speculation in the same direction, I commit my views to those interested in the subject.

London, March 12th, 1870.

## DETERMINATION OF SULPHUR IN IRONS.

By H. B. HAMILTON,  
Millfields Iron Works, Staffordshire.

THE following process will, it is believed, be found a convenient modification of that described in Fresenius's "Quantitative Analysis," since it not only dispenses with the trouble of oxidation by fusion, but effects much saving of time. A weighed quantity of iron (for puddle bars not less than 10 grms.) is thrown into a capacious flask, about an ounce of water is added, and the whole agitated to prevent caking in the after process. A cork is inserted into the mouth with two perforations, the one for a thistle funnel with tube and bulb, curved as represented in Fresenius's "Quantitative Analysis," to admit acid; the other for a tube bent at right angles. The latter tube communicates with a U-tube, containing a solution of caustic potash free from sulphate. (I attached another U-tube to the former one, containing a solution of oxide of lead in

\* *Proceedings of the Royal Institution*, vol. iv., p. 277.

† *CHEMICAL NEWS*, vol. xxi., p. 114.



caustic potash.) Sometimes concentrated hydrochloric acid, and sometimes water, are to be poured in at the funnel, according to circumstances. As soon as the action, after pouring enough hydrochloric acid into the flask, has almost ceased, the contents of the latter are to be boiled. The flame is then taken away, and, as soon as the ebullition has ceased, air is sucked through the apparatus for about a minute. This process may be advantageously repeated, if, as will easily be discovered, the action of the acid has not entirely ceased. (After several experiments the second U-tube did not show the slightest blackening.) The contents of the first U-tube are emptied into a beaker, and the U-tube rinsed out with distilled water. A current of chlorine is allowed for some time to pass through the solution, which is then boiled, acidulated with hydrochloric acid, and boiled again, to drive off all hypochlorous acid, when it is precipitated with chloride of barium.

The contents of the flask are filtered through asbestos, and, without washing the residue at all, it is transferred again to the flask, removing every particle from the funnel by means of a small quantity of nitro-hydrochloric acid. After heating, in order to oxidise the black residue with the nitro-hydrochloric acid, water is to be added, and some carbonate of soda, free from sulphate, to neutralise the large excess of acid. After boiling, filter, taking care that the solution is still slightly acid; precipitate with chloride of barium, add the precipitated solution with precipitate to the former one, and proceed in the usual manner.

It will, perhaps, be interesting to some, if I give results of a few of my analyses according to this method:—

	Per cent of S.	Per cent of S.	
	1st anal.	2nd anal.	Difference.
Sample No. I. .. ..	0.038	0.026	0.012
„ No. II. .. ..	0.088	0.073	0.015
„ No. III. .. ..	0.045	0.033	0.012

## ON A NEW METHOD OF MANUFACTURING CAUSTIC SODA,

PATENTED BY M. BACHET, OF PARIS.\*

By R. CALVERT CLAPHAM, F.C.S.

EXPERIMENTS were made by Lord Dundonald as far back as 1790—1794 in making caustic soda by the decomposition of common salt with litharge. This process was conducted on a manufacturing scale by the late Mr. W. Losh, in 1799, and I am indebted to him for some details of the process then in operation.

The proportions recommended to produce the best results were 100 parts of salt and 300 parts of oxide of lead; but, when the greatest care was taken, they did not succeed in obtaining more than 3.0 parts of caustic soda; or 5.6 per cent of salt was decomposed. At that time, they had many difficulties to contend with in preventing the loss of lead in the solutions; and they had no plan in operation to re-convert the white lead pigment, which was formed back again into an oxide of lead, ready to receive a fresh charge of salt. They had, therefore, to contend with considerable expenses, and some loss of lead in melting it down again to a metallic state. It was only the high price of soda (which may be calculated as equal to £85 to £90 per ton of 70 per cent caustic soda) which enabled the operations to be conducted at a profit. I shall not trouble the Members with any details of the changes which have taken place in the manufacture of soda from that time to the present. It is sufficient to say that, after three-quarters of a century has passed away, a patent has been taken out by M. Bachet, of Paris, for the production of caustic soda by means of salt and litharge, which, in some respects, resembles the old

method, but with this marked difference—that hydrate of lime is added to the mixture, which has the effect of preventing the reactions which take place between the soda and the chloride of lead by the old method, resulting in the re-conversion of the chloride of lead into common salt. And the new process also includes a method of regenerating the white lead pigment, so that it may be used over and over again. The experiments I am about to describe have been conducted by the Walker Alkali Company, at Walker, during the past nine months. Many trials were made as to the best mixtures to be used; but, as far as has yet been ascertained, the following produce good results:—

100 parts of litharge,
70 „ salt,
50 „ lime.

About 5 cwts. of this mixture is ground on a mill, a small quantity of water being added to dissolve the salt. It forms a white, pulpy mass, which is ready to be drawn off the mill in a quarter-of-an-hour. Indeed, as far as experiment can prove, it appears as if the decomposition was almost instantaneous; and, if the operation is properly conducted, about 19 to 20 per cent of the salt is converted into caustic soda. It will be seen hereafter how the remainder of the salt is treated. The decompositions on the mill appear to be threefold—the production of caustic soda, of chloride of lead, and of hydrate of oxide of lead; a portion of the salt and the litharge remaining unacted upon. The pulpy material drawn from the mill is pumped into a press, which is worked at a pressure of 145 lbs. to the square inch. A clear liquid runs out, consisting of caustic soda and brine, containing a variable quantity of lead. With the object of separating completely the small quantity of lead from the soda solutions, various plans have been tried.

Sodium sulphide separates the lead easily; but there are some objections to this process.

Carbonate of soda also precipitates it as a carbonate; but, in some cases, for reasons difficult to explain, the action is not certain.

The simplest method which has been pursued is to pass the solution through hydrate of lime in the form of a filter. All the lead is precipitated; and, on testing the filtered solutions, they only give a slight colour when treated with sodium sulphide.

The lime containing the lead is afterwards used on the mill, in the place of fresh lime.

When the liquors are free of lead, they are then evaporated in an iron pan, like an ordinary salt-pan; and the salt which deposits at the bottom is gradually fished out, and may be again used, with fresh oxide of lead, on the mill.

But the process may be varied, so as to produce a much larger decomposition of the salt, by running the liquors from the press back again on to the mill, and adding thereto fresh charges of litharge and lime.

In this way, 47 to 50 per cent of the salt may be decomposed and converted into caustic soda; and a much stronger soda liquor is obtained to evaporate in the pans, a considerable amount of labour and cost of coals being saved. In either case, the solutions are concentrated till they are ready to be run into a caustic pot, where they are finished in the usual way, producing, with ordinary care, a caustic soda of 70 per cent.

We have now finished with the solutions, and must return to the dry white-lead cakes left in the press before described, the treatment of which forms one of the most important features in the patent.

When freed from its soda solutions it consists of—

Chloride of lead,
Hydrate of lead,
Litharge unacted upon,
Lime unacted upon.

\* Read before the Newcastle Chemical Society, March 24th, 1870.



As hydrate of lead has no action in decomposing salt, it becomes not only a question of how to decompose the chloride of lead, but also how to convert the hydrate into an oxide which will again act upon salt. The method which appears most likely to effect these ends, is, in the first instance, to dry the material from the press, at a temperature of about 350° F. It turns to a fine orange-yellow colour, and the hydrate is decomposed and is converted into a heavy oxide.

The mass is then slowly thrown into a boiling solution of lime-water, in which the chloride of lead is decomposed, forming chloride of calcium and oxide of lead. This solution is now run off, and after one or two washings in fresh lime-water, the lead is again fit to be used at the mill. The liquors which are run off, however, are not to be thrown away, as they contain lead in solution, and it is necessary to separate it to prevent loss.

This is not a difficult operation, as in the cooling of the hot liquors the lead nearly all deposits in fine long crystals, and the remainder left in the solution is precipitated by means of common salt or hydrochloric acid, so that a mere trace remains on testing with sodium sulphide; the chloride of lead thus obtained is decomposed with lime-water as just described, and the oxide applied to the mill. From this it appears that, with ordinary care, all the lead may be recovered, but it is only fair to allow that, in conducting a large manufactory, a portion will be lost, which requires to be estimated for in the cost of production.

Thus far the process appears to work quite smoothly, but the regenerated lead obtained as above described does not in all cases act the same. Sometimes its action is quite as energetic on salt as the original litharge, but in other cases it has proved less satisfactory when worked frequently over again in the process. The cause of this change is not always sufficiently clear; in some instances, during the heating of the material, Pb 3.04, and Pb 0.2, are formed, both of which, I find, have no action on salt. Another difficulty has been in the rapid absorption of carbonic acid by both the hydrates of lime and of lead, resulting in a product which has not only no action on salt, but appears, to a large extent, to prevent the free action of the oxide of lead. When, however, the process is conducted quickly, the regenerated oxide of lead may be used over and over again more frequently; but, so far as experiment has proved, it appears likely that, after five or six operations, it will be necessary to calcine a portion of it, and this is proposed to be effected as under. It is mixed with water, and the lighter portion syphoned off, settled, and dried. This portion, which is found to contain nearly all the carbonates, is then calcined at a strong red heat, in a furnace constructed with a working bed of hard mountain limestone, but a roof of ordinary fire bricks. It parts with its carbonic acid quite easily at a red heat, and is then ready to be used in the mill again.

Such is briefly an outline of this patent, and the importance of a new process, with the object of producing caustic soda by more direct means than at present exists, cannot be exaggerated. Without taking into account the total production of soda, but confining the calculation to caustic soda alone, we find that 20,000 tons of this article are now made in England, of the value of £350,000 annually. The plant required is not expensive, consisting chiefly of mills, presses, evaporating pans, and furnaces.

On the whole, there appears a reasonable prospect, when M. Bachet's patent is fully worked out in practice, that caustic soda will be made at a considerable reduction in cost on the present plan. But as there are gentlemen present who understand these subjects in all their bearings so well, I now leave the result of the experiments in their hands, and shall be happy to hear their criticisms.

## ON MICROSCOPICAL MANIPULATION.

By W. T. SUFFOLK, F.R.M.S.

(Continued from p. 125).

### LESSON V.

THE results of aquatic collecting will require a somewhat different treatment from that recommended in the preceding lessons. Owing to the density of the medium in which the objects are viewed, and the generally diaphanous nature of the organisms themselves, comparatively little use can be made of reflected light as a means of illumination; its employment is, therefore, rather the exception than the rule.

An account of the varied modes of collecting objects of this kind, and their habitats, would almost occupy a volume. For obtaining fresh-water specimens, advantage may be taken of the excursions of the various London and provincial societies. The Quekett Microscopical Club arranges a series of excursions, which take place every fortnight during the summer months; and, as experienced naturalists always accompany these expeditions, the student may derive much practical instruction in the way of collecting and identifying specimens. The microscope should always accompany the student to the sea-side during a temporary residence, and it is well, if possible, to take the usual working instrument, well equipped with objectives and apparatus, and not some small contrivance which has nothing to recommend it but portability. The following works also contain useful information on the subject of marine and fresh-water collecting:—"Handy-Book of Algæ, &c.," Rev. W. W. Spicer; "Beale," p. 146; "The Aquarium, Devonshire Coast, Tenby, &c.," P. H. Gosse; "Seaside Studies," G. H. Lewes; "Marvels of Pond Life," H. J. Slack; "History of Infusoria," A. Pritchard. See also list of microscopical works in "Beale," p. 364.

The preliminary examination of a quantity of aquatic material is generally most conveniently done in a large trough (Fig. 15, vol. xx., p. 181), with a low power, O3,\* and *dark-field illumination*, mirror turned aside, or *long-focus spotted-lens*; the paraboloid has too short a focus for this purpose.

A good diagnosis can often be made by examination in the bottle or tube in which the collection is brought home, with the pocket-lens. Many of the larger animals and plants can be distinguished with this low power, and those too small to be distinctly made out can often be identified by a trained eye. Objects in water may be very conveniently examined out of doors with the pocket-lens, if placed between two small pieces of glass (a 3×1 slide cut in half, and the sharp edges smoothed with a corundum rubber, answers well): these can be kept in the waistcoat pocket, ready for use.

Portions required for more minute examination, if on plants, may be detached with the scissors or forceps. Free-swimming animals, and plants, or deposits, may be taken up with a suitable pipette, by closing the upper end with the finger, and bringing the other extremity over the object to be secured. The finger is then to be removed; and the water rushes in, carrying the object with it. The finger is

\* Ross's 4-inch objective is very suitable for this kind of work; it defines well, bears a considerable amount of eye-piece power, will take in an object of about 0.4 inch diameter, and is low in price.



again applied, to close the top of the tube, which is then lifted out of the water, and the object transferred to a slide-cell or other convenient vessel.

If the object is very thin, a common slide, covered with a piece of thin glass, will serve for the examination with a tolerably high power. Should the object be liable to injury from the pressure of the cover, a cell may be used, or a hair placed between the thin glass and the slide. In all cases in which the object is required to be kept for some days, the growing-slide (Fig. 16, vol. xx., p. 181) should be used: some of these may conveniently be made with cells attached. The thin trough (Fig 14, vol. xx., p. 181) may sometimes be useful. All these contrivances permit the employment of the paraboloid for dark-field illumination, and also the achromatic condenser. The live-box supplied with most microscopes is sometimes useful, but has the disadvantage, from the height it raises the object above the stage, of preventing the employment of any sub-stage illuminator but the mirror.

It is frequently necessary to subject the substance under examination to pressure. For this purpose, an instrument known as a compressorium is necessary, two of which, more completely fulfilling the requirements of the microscopist than older contrivances, are the invention of the late Richard Beck (*Quarterly Microscopical Journal*, vol. xii., p. 4); we are also indebted to him for a live-trap for confining small active animals within the field of the microscope, without compressing them or otherwise restraining their movements (*Quarterly Microscopical Journal*, vol. xiii., p. 113).

The habits of marine or fresh-water animals may be watched in aquaria, which need not of necessity be expensive: basins and glass jars answer the purpose extremely well. The marine aquarium should always be carefully examined after the introduction of fresh specimens of seaweed, as they usually bring in with them large numbers of minute animals.

The author, instead of throwing away the results of fresh-water collection when done with, places them in a tank in the garden, used for growing aquatic plants, which, although only containing about 200 gallons of water, always yields a rich supply of microscopic objects, most of which regularly breed and appear from year to year.

(To be continued.)

## GLASGOW PHILOSOPHICAL SOCIETY.

(CHEMICAL SECTION).

Ordinary Meeting, March 14, 1870.

Mr. ALEXANDER WHITELAW, Vice-President, in the Chair.

MR. W. R. HUTTON read a paper on "*Canadian Phosphate of Lime, and some other Mineral Phosphates now Used in Making Superphosphate of Lime.*" The author mentioned that many mineral compounds having different characteristics both in physical appearance and in chemical compounds, as well as in results when operated upon, are now used in the manufacture of artificial manures, and referred to the fact that agriculturists are annually making greater demands upon the manufacturers of superphosphate of lime. He stated that, in general terms, the value of a mineral phosphate depends upon the percentage of phosphoric acid contained in it, but if there

is any marked quantity of carbonate of lime present, the value of the phosphoric acid is much reduced, owing chiefly to the large quantity of sulphuric acid required to decompose the carbonate of lime before the phosphate can be reduced. The same remark holds true with reference to phosphatic minerals containing iron compounds in combination; the iron takes up its own equivalent of sulphuric acid, and as it is peroxidised a compound is formed which is positively injurious to plant life. Fluoride of calcium is also invariably found in phosphatic minerals, and it, too, requires sulphuric acid, thus increasing the cost of the superphosphate formed, while the gaseous fluorine compounds set free are a source of annoyance. No mineral phosphate has been so extensively employed as coprolites, and none is so little understood and valued by agriculturists. Although agriculturists, and even some manufacturers of manures, are inclined to look suspiciously upon the superphosphate of lime made from coprolites, Mr. Hutton said that his experience went to prove that superphosphate of lime is always of the same chemical value as a manurial agent, no matter what source it is obtained from. After referring to the origin and nature of coprolites, and the extent of the deposits in Cambridgeshire, Bedfordshire, and Suffolk, from which upwards of 200,000 tons are annually raised, the author proceeded to speak of the necessity for additional sources of mineral phosphates being resorted to, and new deposits being brought within the reach of manufacturers of manures, even if brought from other countries. He spoke of the German and Spanish phosphates as being very extensively had recourse to, although not so valuable as the English coprolites. Reference was made to a large and valuable deposit which occurs in South Carolina, and which has recently been brought into notice. Mr. Hutton mentioned that he was supplied some months since with specimens of phosphate of lime from Canada, obtained from a face of the material nearly fifteen feet in width, and presenting, so far as yet examined, an excellent supply of the raw material. The samples differ very much from those phosphatic minerals which are now in use, and seem to indicate that if a sufficiency can be obtained the Canadian mineral will be welcomed by manure manufacturers. Some of the specimens sent were distinct six-sided prismatic crystals, while the other pieces were in masses; but both crystals and masses had a vitreous lustre, the colour on some parts being green and bluish-green, and in other places red. The following analyses were given:—

	Masses.	Crystals.
Phosphate of lime.. ..	86.61	90.82
Fluoride of calcium .. ..	7.22	5.70
Chloride of calcium .. ..	0.06	0.14
Carbonate of lime .. ..	4.47	0.38
Moisture.. ..	0.08	0.32
Sand .. ..	0.10	0.10
	98.54	97.46
Oxide of iron .. ..		0.40
		97.86
Specific gravity .. ..	3.142	3.166

In a physical point of view this Canadian phosphate differs from all others in being crystalline and not granular; while it differs chemically in containing more phosphate of lime and less carbonate of lime and sand.

A short discussion followed the reading of the paper.

Mr. JAMES MAHONY afterwards read a paper entitled "*A Note on Plate Sulphate of Potash.*" This compound is obtained as a product from kelp, either by direct crystallisation from the lyes, or by solution and crystallisation of the granulate sulphate which is precipitated in the process of boiling down the liquors. When the liquor is about 42 to 44 of Twaddell, it is run into coolers, and in a day or two crystals are formed. The



liquor is again saturated with soft sulphate, and a second crop of crystals is obtained on the first, and so on till a cake of sufficient thickness is produced. This salt is really a double sulphate, a fact first noticed by the late Dr. Penny; but the author of the paper finds that in practice the salt never contains more than from 73 to 75 per cent of the potassic sulphate instead of 78.56, as would be the case if the salts were present in the proportion of three of potassic to one of sodic sulphate. The plates enclose, during the time of their formation, small portions of the mother liquor which, becoming crystallised, account for the presence of chlorides and other salts, and thus diminish the percentage of potash. The well-defined crystals on the surface of the plates are almost pure. One of them examined by the author gave 77.60 per cent of sulphate of potash. Being clearly a double salt, the author said it might be expected that its solution and re-crystallisation would only have the effect of yielding a purer and more typical double sulphate. But this is not the case, for its component salts then become separated from each other in the order of their respective solubilities. Mr. Mahony proved this by operating upon five pounds of ordinary plate sulphate of potash, roughly pounding and dissolving in a sufficiency of boiling water. The insoluble matter was allowed to settle and was separated by a calico filter. The whole of the solution at 25° of Twaddell, was boiled down to 38°, when a pellicle formed on the surface. On analysis the first crystals gave—

KOSO <sub>3</sub>	..	..	..	..	86.23
NaOSO <sub>3</sub>	..	..	..	..	13.83
					100.06

There was not a trace of chlorine. The salt deposited at the bottom gave—

KOSO <sub>3</sub>	..	..	..	..	84.26
NaOSO <sub>3</sub>	..	..	..	..	15.66
					99.92

The pellicle of crystals on the surface gave KOSO<sub>3</sub> 81.16. After removal of the first crop the mother-liquor was again boiled down to 38° Twaddell, and a second crop of crystals similar in appearance to the first gave—

Crystals	..	..	..	82.09	KOSO <sub>3</sub>
Bottom	..	..	..	77.65	..

The operation of boiling down and crystallising was performed six times. In the fifth crop there was a layer of sulphate of potash with large well-defined crystals of sulphate of soda on the top; and the sixth crop was chiefly sulphate of soda. The total quantity of salt removed was 4 lbs. 13 ozs., containing 3 lbs. 10.36 ozs. of pure sulphate of potash, the insoluble and loss amounting to 3 ozs. Sulphate of soda being the more soluble salt of the two was thus shown to remain in the liquor to the last, and, therefore, plate sulphate of potash cannot be classed in the category of ordinary double salts which remain of similar composition on re-crystallisation. In conclusion, the author referred at some length to the phenomenon of phosphorescence observed in the course of the process of crystallisation. He said it was affected by climatal influences, being more brilliant on some nights than others, and thus it might be assumed to be due to the electrical condition of the atmosphere.

A short discussion followed, in the course of which it was suggested that as Mr. Mahony was as accomplished as a naturalist as he was skilled as a chemist, he should give the section a paper on the phenomenon of phosphorescence as illustrated both by crystallising minerals and by the sea.

Votes of thanks were awarded to the authors of both papers.

## NOTICES OF BOOKS.

*The Private Life of Galileo.* Compiled principally from his correspondence, and that of his eldest daughter, Sister Maria Celeste, Nun in the Franciscan Convent of S. Matthew, at Arcetri. London: Macmillan and Co. 1870. 307 pages.

WE are extremely glad to welcome the issue of another life of Galileo; for, although many such have been published, they have, for the most part, appeared in Italy and France, and are but little known in this country. The most detail work is perhaps Albèri's "Opere Complete di Galileo Galilei," which was published in Italy, between 1842 and 1856. In this country, we scarcely know where to look for a work which gives anything like a definite idea of Galileo's works, of his life, and of the times in which he lived; and, although the work before us purports to be confined to his private life, it contains many interesting details in regard to his scientific labours, and his persecution by the Church of Rome.

Galileo was the eldest son of Vincenzo de' Bonajute de' Galilei, a Florentine nobleman, and was born at Pisa, on the 18th of February, 1564. His father appears to have been a man of great culture, and was the author of several works on counterpoint, which, having been invented about the twelfth century, had attained some degree of perfection by the sixteenth. Galileo acquired a great love for music from his father, and is said to have excelled him as a performer on the lute; throughout his life, specially when blindness and bodily ills were added to his other troubles, he delighted in the soothing effect of his instrument. In painting Galileo also excelled, and it is probable that, if he could have chosen his profession, he would have become a painter.

In 1581, at the age of seventeen, Galileo was sent to study medicine at the University of Pisa, an intensely conservative institution, where Aristotle, and Aristotle only, was considered the fountain-head of all knowledge.

It was during his residence at Pisa that he discovered the pendulum. He noticed the extreme regularity of the oscillation of the great bronze lamp in the nave of the Cathedral, and was thus led to imagine that an instrument might be constructed which, by the alternation of its oscillations, would mark the regularity and variation of the pulse. This instrument he constructed, and it was much used by the physicians of the day, under the name of *pulsilogia*.

When we remember how great a mathematician Galileo became, it is strange to learn that the study of mathematics was entirely neglected in the University of Pisa, and, indeed, in Italy generally. It was considered a waste of time to solve problems, and the name of Euclid was almost unknown; indeed, Galileo was obliged to pursue his mathematical studies clandestinely, and it was only when his father saw that he possessed an extreme aptitude for them that he permitted them to be continued. Accordingly, Galileo worked hard at the writings of Euclid and Archimedes; he reached the sixth book of the former, and had already invented several problems. In 1586, while studying the works of Archimedes, he composed his first essay, on the "Hydrostatic Balance," which was not published, however, till 1615. In 1588, he wrote his "Theoremata Circa Centrum Gravitatis Solidarum," which was not published till 1638, and then in the form of an appendix to the fourth of the celebrated "Dialogues." The "Essay on the Centre of Gravity of Bodies" led to the introduction of Galileo to Ferdinand, Grand Duke of Tuscany, who appears to have admitted him to a considerable degree of intimacy. In 1689, Galileo was appointed Professor of Mathematics at Pisa, with a salary of sixty crowns per annum, that is, about ten-pence per day. With one exception, Galileo had not a friend among the Pisan Professors, for they were firm believers in Aristotle; and, when Galileo proved the falsity of



Aristotle's laws regarding falling bodies by experiments in public, made on the summit of the Leaning Tower of Pisa, the anger of his colleagues was soon made manifest. In 1592, Galileo resigned the Professorship at Pisa, and became Professor of Mathematics in the University of Padua, with a salary of 180 florins a-year (about £32). The Paduans recognised his genius somewhat tardily: when he had been among them seventeen years, the Senate of the University, bearing in mind his discovery of the telescope, and his labours "to the gain of the University, and to the satisfaction of all," gave him the Professorship for life, with a salary of a thousand florins.

In 1609, Galileo invented the telescope. It was first called *cannocchiale* or *occhiale* (eye-glass); and the term *telescope* was introduced by Prince Fredrigo Cesi. The invention was very much combated, even by Galileo's own countrymen; it was claimed by the Dutch, and many older writers (among them Baptista Porta and Antonio De Dominis) were mentioned as prior inventors. By means of the new instrument, Galileo discovered the satellites of Jupiter, in 1610; he called them *Medicea Sidera*, in honour of Cosmo de' Medici and his brothers, Francesco, Carlo, and Lorenzo. Galileo constructed more than a hundred telescopes, and sent them as presents to various monarchs and princes of Europe: only ten of them were capable of showing the satellites of Jupiter. The excitement created by the invention was intense; everyone was anxious to see the new instrument: "we are told how Marie de' Medici, in her eagerness to see the moon through the telescope, would not wait for it to be adjusted, but went down upon her knees before the window, thereby greatly astonishing the Italian gentleman who had brought the telescope into the royal presence." In July, 1610, Galileo discovered Saturn's Ring; in the following October, the phases of Venus; and, in March, 1611, the Solar Spots.

In 1613, Fra Benedetto Castelli, a pupil of Galileo, was appointed Professor of Mathematics at Pisa, but was specially cautioned to make no mention of the Copernican theory of the earth's motion, which, since the discovery of Jupiter's satellites, had been somewhat openly discussed. Galileo wrote to Castelli, during the course of this same year, on the subject of the Copernican theory, and asserted that the Ptolemaic system (then received by the Church) did not, in many respects, accord with Scripture. We may quote a few passages of this celebrated letter in full:—"But I should in your place have added that, though Scripture cannot err, its exponents and interpreters are liable to err in many ways; and one error in particular would be most grave and most frequent if we always stopped short at the literal signification of the words. For, in this wise, not only many contradictions would be apparent, but grave heresies and blasphemies; for then it would be necessary to give God hands, and feet, and ears, and human and bodily emotions, such as anger, repentance, hatred, and sometimes forgetfulness of things past, and ignorance of the future." . . . "And who can assert or sustain that, in speaking incidentally of the sun, or of the earth, or of other created bodies, Scripture should have elected to restrain itself rigorously to the strict signification of the words used? May it not be that, had the truth been represented to us bare and naked, its intention would have been annulled, from the vulgar being thereby rendered more contumacious and difficult of persuasion in the articles concerning their salvation?" A copy of this private letter, obtained, it is believed, by treachery, fell into the hands of the Dominicans of the Convent of S. Mark, and incensed them to such a degree that they determined at once to denounce Galileo to the Holy Office, and, if possible, procure his destruction. The controversy was immediately introduced into the pulpit; and the Dominican Caccini preached a violent anti-Copernican sermon, at S. Maria Novella, on the punning text, "Ye men of Galilee, why stand ye gazing up into Heaven?" The opponents of Copernicus (who, in reality, knew nothing

about him) forgot that he was a Canon of their Church, and had been summoned to Rome by Leo X., to the Council of the Lateran, in order to re-model the Church Calendar. Caccini was ordered to repair to Rome, and was examined in March, 1615, in regard to what he knew of Galileo and his followers. Both Caccini and Lorini denounced Galileo to the Holy Office, and thus paved the way to the celebrated trial of 1633. Near the close of the year 1615, Galileo went to Rome to plead his own cause. Early in the following year, he had an interview with the Pope (Paul V.), who conversed with him for three-quarters of an hour, and was altogether very gracious, assuring him that he need fear no persecution by the Congregation of the Holy Office, during his Pontificate. Paul V. died in 1621, and Gregory XV. was elected in his stead, but he reigned only two years; and, in August, 1623, Maffeo Barberini became Pope, and assumed the title of Urban VIII. When Cardinal, the new Pope had been on somewhat intimate terms with Galileo; had called him "affectionate brother," and had written Latin sonnets in praise of his works. It was hence imagined by the reform party that science would find a patron and protector in Urban; Galileo, indeed, went so far as to hope and imagine that he would recognise the Copernican theory. "Under the auspices of this most excellent, learned, and benignant Pontiff," wrote Prince Cesi, "science must flourish. . . . Your arrival will be welcome to his Holiness. He asked me if you were coming, and when; and, in short, he seems to love and esteem you more than ever." In April, 1624, Galileo started for Rome, where he remained about two months, during which time he had six interviews with the Pope, who gave him various presents on his departure, and "an ample provision of Pontifical love."

Galileo's "Dialogue on the Ptolemaic and Copernican Systems" had for many years been partially written. It was finally concluded in March, 1630; and, in the following May, Galileo went to Rome to make arrangements for its publication. Urban VIII. gave him permission to publish the work with certain slight alterations and additions; but, at the same time, to his great disappointment, told him that the Copernican system could not be recognised by the Church, and must be treated as mere hypothesis. The "Dialoghi" appeared in January, 1632, and was favourably received by all Italy. Suddenly, however, about six months after its appearance, an order was issued from the Master of the Sacred Palace to sequester every copy throughout Italy, on the authority of the Jesuit Inchofer, one of the Consultori. The Grand Duke of Tuscany, the principal patron of Galileo, wrote at once to Niccolini, his Ambassador at Rome, to enquire the cause of the sudden change of the Pope's views. Niccolini at once requested an audience. When Galileo was mentioned, Urban became furious: he said he had grossly deceived him, and had dared to publish matters which ought never to have been so much as mentioned; moreover, that the Papal suggestions had not been complied with. The Jesuits ruled the Roman Court then, as now; and certain Jesuits of influence instilled into the Pope's mind the fabrication that, in the person of Simplicio (one of the three characters in the "Dialogues"), Galileo had intended to hold him, the Sovereign Pontiff, up to ridicule. This, once admitted by Urban, sealed the fate of Galileo and of his work. In October, 1632, he was cited to appear at once before the Inquisition; and, although everything was urged against his appearing in person for trial, the Pope would listen to no excuse. Galileo was very old and feeble, and his health was bad. It must be confessed that the three doctors who drew up the medical certificate of the state of his health made the very best case they could for their client, in regard to his unfitness for the journey to Rome. They found him to possess an intermittent pulse and a certain amount of debility; then comes the heaping up of bodily ills—"Riferisce il detto patire di vertigini frequenti, di melancolia hipocondriaca, debolezza di stomaco, vigilie, dolori vaganti per il corpo,



si come da altri può essere attestato. Co se anco haviamo riconosciuto un hernia carnosia grave con attentatum del peritoneo." It was no use, however; the Inquisition would not spare him; and he was forced to make the journey to Rome during mid-winter, through a bleak and dreary region.

Now, his trial and the results thereof, and his abjuration, and imprisonment, and the sentence (which included a recitation of the seven penitential Psalms once a week for three years), are they not written in numerous and diverse books, and, to a greater or less extent, in the minds of all of us? One thing we must allude to, in conclusion: it is usually said that, when Galileo rose from his knees, after abjuring the doctrine of the earth's mobility, he muttered—*Eppure si muove!* ("It does move, notwithstanding"). The author of the work before us very justly remarks—"This is one of those fine things which are put into the mouths of great men, but which, in fact, are not said, except by their biographers. It is, indeed, impossible that Galileo should have uttered such words as would have caused his instant consignment to the deepest dungeons of the Inquisition." We remember a recent example of these fine sayings which are put into the mouths of great men. When the Tsar was fired at, in 1867, during his visit to Napoleon III., there were no less than *seven* different statements, in various Paris papers, of the sayings of the Emperor and the Tsar the moment after the shot had been fired. These sayings were so evidently dramatic in their character, and unlike the real remarks which might be expected to be made under such circumstances, that the wonder is they obtained a moment's credence. We remember but one of them—"Sire," said Napoleon III., "we have been under fire together." "Our destinies," replied the Tsar, "are in the hands of Providence." M. Ponsard has not allowed such an incident as the *Eppure si muove* saying to pass unnoticed in his "Galilée;" indeed, he makes it the culminating-point of the drama, and also ingeniously gives Mde. Favart a last chance of showing her filial affection as Antonia—

*"Le President, à Galilée.*

La prison qu'on t'assigne est un cloître à Livourne,

*Antonia, se jetant dans les bras de Galilée.*

Va, nous t'y suivrons, père.

*Galilée, à part, en se relevant et en frappant du pied en terre.*  
Et pourtant elle tourne."

Let us add one word, in conclusion, in regard to the treatment of Galileo by the Church, and his actual position. It has been the custom to see in him only an injured and persecuted man; to absorb everything appertaining to the man into the martyr. A lot of nonsense and rant has been written against the Church of Rome, because it suppressed his book; while we forget what our own Church, which pretends to no bigotry, has done; and how, even now, more than two centuries from the time of Galileo, a very little matter of assumed heterodoxy arouses the whole Bench of Bishops, and renders Church literature inflammatory, and often unjust. We need scarcely allude to a recent example of this; and, while it is before us, we may not cry shame on Rome for her treatment of Galileo. Next, as to the man: he is called "the originator of true experimental philosophy," "the father of modern natural philosophy," and so on; some put him before Bacon and Descartes; some assert that he caused the downfall of Aristotelianism. Expressions and ideas of this kind become stereotyped in the human mind. They are bandied about from book to book, and from mouth to mouth; they are accepted without comment; and the full question is rarely examined and weighed. The attitude of human thought in such matters of hearsay and tradition is intensely conservative; its inertia is enormous; its condition of stability is established, and cannot easily be altered. Without doubt, Galileo ranks among the greatest natural philosophers

which the world has ever seen: his discoveries are numerous and great; his influence on modern philosophy, although less than that of Bacon and Descartes, was undeniably great. A great many people, however, ignore the fact that Copernicus originated the theory of the earth's mobility, and that there were ten Copernicans in Europe in the sixteenth century, one of whom was our Gilbert, of Colchester. As regards the downfall of Scholasticism, the way had been prepared for this by such men as Aconcio, Nizolius, and Telesius. But most eminent among them all, as one who fearlessly and in the face of persecution asserted the truth and strove to break down the old barriers, was Savonarola. Free thought, and open expression of it, had been practised long before the time of Galileo. The world was ripe for the change. Galileo did not till the soil; he did not even sow the seed; but he helped to garner a mighty harvest. It is right that he should be one of the glories of science; but, to be just, we must not allow enthusiasm to distort our estimate of his chequered and not always admirable life.

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

*Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

*Comptes Rendus des Séances de l'Académie des Sciences, March 21 1870.*

The number contains the following original papers and memoirs relating to chemistry and allied sciences:—

Analysis of, and Useful Applications of, Gaize.—H. Sainte-Claire Deville and J. Desnoyers.—There occurs, in the Département des Ardennes, France, a variety of hydrated silica known by the name of gaize, and geologically situated below the cretaceous deposit; the thickness of this layer is 30 metres, and it extends over a distance of 40 kilometres (24·85 English miles). The sp. gr. of this substance is 1·48 in crude state, and after ignition 1·44; in 100 parts, it consists of—Hygrometrical water, 3·4; combined water, 3·2; soluble silica, 43·7; insoluble silica, 40·8; alumina, 3·8; peroxide of iron, 2·9; lime, 0·9 (we only quote one of the very large number of analyses mentioned in this memoir). This stone is used as a building stone; it is, at first, quite soft, so that it can be cut with a knife. Since the authors found that this material resists a very high temperature without fusion or cracking, or, also, of perceptible contraction, either cubical or linear, they recommend it for the manufacture of crucibles (on the lathe), for fire-bricks, and for furnaces. Some specimens of bricks and crucibles made from this material were exhibited at the meeting.

Variations of the Calorific Capacity of Water when Approaching its Maximum of Density (Specific Gravity).—M. Hirn.—A memoir of considerable length, and too full of figures to admit of useful abstraction.

Action of Sulphide of Carbon and Carburetted Gases (*des gaz carburés*) on Wood Charcoal.—J. Sidot.—The author describes, at some length, a series of experiments made by him. When the vapours of sulphide of carbon, of wood-spirit, and some of the liquid hydrocarbons are passed over wood charcoal at an elevated temperature, that substance undergoes, at least superficially, a very curious change, and is converted into a sonorous, metallic-looking material, becoming, at the same time, a good conductor of heat and electricity, and no longer capable of absorbing gases; it is, in fact, converted into a peculiar kind of graphite, but only superficially.

On Cobalt and Manganese, and their Alloys with Copper.—A. Valenciennes.—The author exhibits specimens of cobalt and manganese fused in crucibles made of magnesia. The former metal is very similar to iron, but far harder, yet readily wrought in the lathe. Manganese is a very hard, but brittle metal, very readily oxidised in the air; the specimen was pure, having been made from pure peroxide. Notwithstanding the similarity cobalt possesses to iron, the former readily alloys with copper, which iron does not. The alloys of manganese and copper are very similar to those of copper and tin, but very hard and brittle when the proportion of manganese is above 8 per cent of the mixture.

Vertical Beam Galvanometer.—M. Bourbouze.



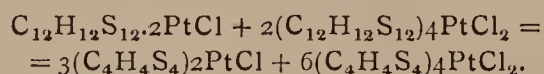
**Electro-Chemical Essay on Ozone.**—E. Martin.—This paper was not read—its title only is mentioned.

**Nature of the Motive Power which Produces the Phenomena of Endosmosis.**—A. Rosenstiehl.—This lengthy memoir, full of quotations from other periodicals, is not well suited for any useful abstraction.

**New Method of Preparation of Bromhydric Acid.**—MM. Champion and Pellet.—This process is based upon the reciprocal action of the vapours of bromine upon those of paraffin, the latter substance being heated to 185°, and the former to 65°, each in a separate retort. The somewhat complex reaction results, ultimately, in the formation of bromhydric acid, of which, by this means, a concentrated aqueous solution is obtained, which, if saturated at 0° (32° F.), has a sp. gr. of 1.78, and contains, in every c.c., 1.46 grms. of bromhydric acid, while the formula of this compound is  $\text{BrH}_2\text{HO}$ . On being heated, gas is evolved; but, simultaneously, a hydrate is obtained boiling at 126°; its formula is  $\text{BrH}_{10}\text{HO}$ ; its sp. gr. is 1.48.

**Properties of Iodic Acid.**—A. Ditte.—This very lengthy and exhaustive memoir treats (1) on anhydrous iodic acid, and (2) hydrated iodic acid. The paper is a monograph on the subject, but not suited for any useful abstraction.

**Hydrogenated Derivatives of Sulphide of Carbon.**—Aimé Girard.—After referring to older experiments made on this subject, the author states that he has succeeded in substituting hydrogen for half of the sulphur contained in sulphide of carbon, thus constituting a compound containing equal equivalents of carbon, hydrogen, and sulphur. By analysing the compounds this new substance forms with nitrate of silver, chloride of mercury, and chloride of platinum, the author has been enabled to fix the formula of this substance as  $\text{C}_4\text{H}_4\text{S}_4$ , and that it is bisulpho-methylen. The formula of the platinum compound is—



In 100 parts—Carbon, 12.2; hydrogen, 2.0; sulphur, 32.5; platinum, 33.3; chlorine, 20.0.

**Vitality of Beer-Yeast.**—J. Melsens.—This lengthy chemico-physiological memoir is divided into the following sections:—Fermentation at 0° (32° F.); freezing of beer-yeast under pressure; freezing of beer-yeast, or of malt, in solution, by means of the paste of ether and solid carbonic acid *in vacuo*; resistance of beer-yeast in wort at a higher temperature; destruction of the vitality of beer-yeast, when the fermentation, produced by it, and going on in a closed vessel, causes the pressure to rise to 25 atmospheres (375 English lbs.) pressure to the square inch. The chief results of the author's researches are—That fermentation is possible in the midst of melting ice, at which temperature seeds do not germinate. Beer-yeast resists (that is, is not deprived of its capability of inducing fermentation) freezing when surrounded by water, and resists the effort of dilatation (expansion) which is so strong as to break vessels capable of resisting 8000 atmospheres' pressure (120,000 lbs.) to the square inch. The energy of the ferment is diminished, but its vitality is not destroyed, by the lowest possible temperature which can be artificially made—viz., about 100° C. below zero. Alcoholic fermentation is suspended when the temperature is maintained for some time at 45° (113° F.). Alcoholic fermentation is arrested, when that operation is going on in closed vessels, as soon as the carbonic acid evolved causes a pressure of 25 atmospheres, and in that case the yeast is killed (*tuée*). The following observations on the contents of this paper were made by M. Bous-singault, who says—"It is not at all remarkable that beer-yeast should resist the action of very low temperatures, since the same has been observed with various kinds of seeds purposely exposed to a cold of -100°, which seeds germinated afterwards." But the speaker takes exception to the fact announced that fermentation should go on at a very low temperature, and states that when he repeated, during the very great cold of the winter of 1848, Vergnette's experiments, he found that ferments were killed and fermentation arrested by that low temperature.

**Chemical Conditions of the Life of the Lower Organised Animals.**—J. Raulin.—A physiologico-chemical paper.

**On Tribromhydrine.**—L. Henry.—The author describes, at great length, the preparation of this body, which, in pure state, is a neutral, colourless, ethereal liquid, of 2.407 sp. gr. at 10°, insoluble in water, and boiling at 219°; by the aid of a low temperature, it can be obtained in crystalline state. Its equivalent is 281; its percentage composition—Carbon, 12.81; hydrogen, 1.78; bromine, 85.40. Formula,  $\text{C}_3\text{H}_5\text{Br}_3$ . The author enters into some details on the action of caustic potassa upon this substance, but has not quite finished his researches in this direction.

**Isomeric Xylens and Cumens met with in Coal-Tar Oils.**—M. Rommier.—A continuation of a former paper on this subject.

**Fall of a Meteorite at Mourzouk (Barbary).**—M. Coumbary.—The author, writing from Tripoli, states that, on the 25th of December last, there was observed, at Mourzouk (Fezzan), lat. 26° N., long. 12° E. of Paris (14° 20' 26" E. of Greenwich), a most extraordinary fall of a meteorite, accompanied by a heavy report of an explosion, and so strong a scintillation of sparks, that a group of Arabs, who were near the spot, became so frightened that they fired their guns at the heavenly monster. The Turkish Government has very laudably taken proper measures to secure the meteorite; but, since the distance from Tripoli to Mourzouk is very great, and the roads hardly fit for traffic, it is a month's journey to reach the latter place. At the end of this letter, it is incidentally mentioned that, in the farther interior of this region (Africa), the Sultan of Wadai, and all the grand personages of his Court, are armed with swords, lance-heads, and sabres made from iron fallen from heaven, which is very abundant there.

*Revue des Cours Scientifiques de la France et de l'Etranger*  
March 26, 1870.

This number does not contain any papers relating to chemistry, but we quote the titles of the following memoirs of general scientific interest met with in these pages:—

**Existence of Man at the Tertiary Period.**—A. Favre.

**Spectroscopic Observations of the Solar Protuberances.**—G. Rayet.

**Action of the Sympathetic Nervous System.**—Dr. P. Bert.—A public lecture given to a mixed auditory at the Sorbonne, illustrated with diagrams.

*Revue Hebdomadaire de Chimie*, March 17, 1870.

**Manufacture of Carbonate of Soda.**—MM. Schlœsing and Rolland.—This process is based upon the reaction which takes place when carbonate of ammonia reacts upon common salt, both salts being in aqueous solution. There is thus obtained bicarbonate of soda of great purity, which crystallises; and in the solution there remain chloride of ammonium and an excess of the bicarbonate of that base.

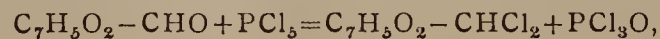
**Peruvian Guano.**—Ch. Mène.—It appears that the Peruvian Government has come to the decision that no guano from the Chincha, Macabi, and other islands, may be exported, except to the United States and the United Kingdom, with the view of settling, by this means, the debts owed by Peru to these countries. The author enters into some details about the fixation of the ammonia in this substance.

**Regenerating Stale and Ropy Beer.**—M. Mène.—According to this process, the liquids alluded to are boiled up, first, with spent hops, and afterwards fermented again; but it is very difficult to see that this treatment can do any good. It is best to use such fluids as stale and ropy beer either for vinegar making or throw it away into the manure of the horses employed at the brewery, since that is its best place.

*Zeitschrift für Chemie von Beilstein*, No. 4, 1870.

This number contains the following original papers and memoirs:—

**Further Researches on the Constitution of Piperic Acid.**—J. Remsen and R. Fittig.—The authors have studied the action of hydrogen, in nascent state, upon piperonal and piperonylic acid. The first of these substances yields, when treated with sodium amalgam and water, three different and well characterised substances, viz.:—Piperonyl alcohol,  $\text{C}_8\text{H}_8\text{O}_3$ , a solid body, fusing at 51°, crystalline, difficultly soluble in water, readily soluble in alcohol, not volatile without undergoing decomposition, and yielding, with chloride of acetyl a fluid acetic ether, while hydrochloric acid is given off. Hydro-piperone,  $\text{C}_{16}\text{H}_{14}\text{O}_6$ , a solid body, insoluble in water, and also in cold alcohol; difficultly soluble in boiling alcohol, from which solution it crystallises on cooling, exhibiting lance-shaped crystals fusing at 202°. Isohydro-piperone,  $\text{C}_{16}\text{H}_{14}\text{O}_6$ , a solid substance, insoluble in cold water, but readily in boiling, very soluble in alcohol, crystalline, and fusing at 138°. The authors describe, at great length, the action of the two last-named substances, in contact with chloride of acetyl and with nitric acid; the result, as regards the latter, being mono-nitro-piperonal,  $\text{C}_8\text{H}_5(\text{NO}_2)\text{O}_3$ , a solid crystalline body, insoluble in water when cold, but better soluble in hot water and boiling alcohol, and fusing at 95°. This very lengthy memoir contains, further, the account of the action of chloride of phosphorus upon piperonal, represented by—



producing piperonal chloride, a fluid boiling at between 230° and 240°. By the action of water and dilute hydrochloric acid, piperonylic acid yields protocatechusic acid and pyrocatechin.

**Isomeric Nitrotoluals and Toluidines.**—F. Beilstein and A. Kuhlberg.—This paper contains the description of the following compounds:—Nitrited acetoluide,  $\text{C}_7\text{H}_6(\text{NO}_2)\text{NHC}_2\text{H}_5\text{O}$ , a solid substance, fusing at 92°, and insoluble in water; isomeric nitrotoluidine,  $\text{C}_7\text{H}_6(\text{NO}_2)\text{NH}_2$ , a solid crystalline body, readily soluble in alcohol, and fusing at 114°; ortho-nitrotoluidine,  $\text{C}_7\text{H}_7\text{NO}_2$ ; ortho-toluidine; ortho-acetoluide,  $\text{C}_7\text{H}_7\text{NHC}_2\text{H}_5\text{O}$ ; dinitrotoluidine,  $\text{C}_7\text{H}_6(\text{NO}_2)_2$ ; meta-iodtoluidine,  $\text{C}_7\text{H}_7\text{I}$ ; solid iodnitrotoluidine,  $\text{C}_7\text{H}_6(\text{NO}_2)\text{I}$ ; chlorotoluidine,  $\text{C}_7\text{H}_6\text{ClH}_2\text{N}$ .

**Contributions from the Technical Laboratory of the University of Kasan (Russia).**—A. Saytzeff.—This paper is divided into the following sections:—On amyl-ethyl-sulphide; action of zinc-sodium alloy upon a mixture of anhydrous acetic acid and iodide of alcohol (*alcohol jodür*); action of pentabromide of phosphorus upon bromacetylene; a new method for the conversion of fatty acids into the corresponding alcohols; synthesis of normal butylic alcohol; synthesis of alcohol (*Weingeist*); synthesis of normal propylic alcohol; on the proportion of oxygen combining with some of the organic derivatives of bivalent (*zweiwerthig*) sulphur; and on the behaviour of iodide of ethyl towards ethyl-bisulphide.

**Action of Ammoniacal Salts upon Oxide of Copper.**—J. Tüttschew.—When finely-powdered black oxide of copper, obtained by the ignition of nitrate of copper, is boiled with a solution of chloride of ammonium for a length of time, the oxide loses its colour and becomes greenish; when, after continued boiling, the mixture is evaporated to dryness, and next exhausted with water, a green powder and a bright blue-coloured solution is obtained. This



powder, after having been well washed and dried, first at the ordinary temperature of the air, and lastly in the air-bath at between 120° and 140°, yields, on analysis, for 100 parts—Water, 17.02; chlorine, 16.10; oxide of copper, 70.05. The substance is, therefore, almost exactly similar to the mineral known as atacamite, from Copiapo, Chili, which, according to Dr. Rammelsberg's analysis, is—



in 100 parts—Chlorine, 15.65; water, 17.88; oxide of copper, 70.00. When the oxide of copper is similarly treated with a solution of sulphate of ammonia, a salt is obtained consisting, in 100 parts, of—Oxide of copper, 67.87; sulphuric acid, 18.73; water, 13.40. Or a substance very similar to the mineral brochantite, from Krisuwaga, Iceland, consisting, in 100 parts, of—Oxide of copper, 67.75; sulphuric acid, 18.88; water, 12.18. With a solution of carbonate of ammonia, which, by-the-bye, is itself decomposed by boiling, a substance was obtained containing, in 100 parts—Carbonic acid, 19.02; oxide of copper, 70.24; water, 10.74. With nitrate of ammonia, a substance is obtained containing, in 100 parts—Oxide of copper, 65.54; water, 18.94; nitric acid ( $\text{N}_2\text{O}_5$ ), 15.52; or very nearly the substance,  $2(6\text{CuONO}_2) + 15\text{HO}$ .

No. 5, 1870.

This number contains the following original papers:—

**On M. Wyruboff's Critical Remarks concerning the Labours of M. Reindel.**—This paper contains the following sections:—Decomposition of ferrocyanide, by means of nitrate of soda, by crystallo-chemical reaction; action of chloride of copper on ferrocyanide of potassium. It is not possible to make any useful abstract of this paper.

**Adulteration of Rice-Meal.**—A. D. van Bastelaer.—According to the author, properly-prepared macerated solutions of flour and meal of wheat, rye, barley, oats, Indian corn, buckwheat, peas and beans, and linseed yield precipitates with concentrated solutions of picric acid. A reaction, due, in all probability, to the action of picric acid upon the albuminous compounds of these substances, which are hardly at all present in rice; and hence the fact that the meal of that cereal yields no precipitate with the reagent alluded to. The method of testing is executed as follows:—20 grms. of the flour to be tested, previously well freed from bran and husk, is mixed with 100 grms. of cold water, and left standing with that fluid, at a temperature of 11° or 12°, for an hour, care being taken to stir the mixture frequently. The mass is next brought on to a filter, and to the filtrate a cold saturated solution of picric acid is added; if this causes, in the case of rice-meal, a precipitate, one may be sure that substance has been adulterated with other meals. The meal obtained from ergot of rye also yields, with picric acid, a precipitate, if treated as above described.

**Property of Amorphous Silicic Acid of Absorbing Moisture from the Air.**—A. Souhay.—The author states that Dr. Lippert, while assistant to Professor R. Fresenius, made the observation that amorphous silica, after having been strongly ignited in a platinum crucible, attracted moisture from the air to a large extent; in consequence whereof, and to test this fact precisely, the author instituted a series of experiments, from which the following results are drawn:—Amorphous silica is always hygroscopic after ignition; the degree of hygroscopicity differs greatly, according to the degree of heat the silica has been ignited—so that feebly-ignited silica is far more hygroscopic than when strongly ignited. When silica has been only feebly ignited, its avidity for the absorption of water, even after the lapse of a few minutes, is so great as to cause, if not taken into account, serious faults in the weighing and quantitative estimation of that substance. Crystalline silica, even when feebly ignited, is not at all hygroscopic.

*Les Mondes*, March 24, 1870.

**Meteorological Observatory at Montsouris.**—To this institution, established by M. C. Sainte-Claire Deville, a grant of £2400 has been made by the French Minister of Public Instruction for the current year, with the arrangement that the peculiar work to be done has to comprise—(1) The complete study of all the facts relating to the climate of Paris, and the observation of the phenomena of physical interest pertaining thereto; (2) the calculation and digestion of the older observations on record; (3) the collection and redaction of the daily observations made in France and abroad, as far as they are published or transmitted daily by telegraph; (4) the daily publishing of all the results of observations made.

**Technical Education and Instruction.**—By decree of the 19th inst., His Majesty the Emperor of the French has, upon the proposition of the Minister for Agriculture and Commerce, approved of the establishment, under the said Minister, of a superior council of technical education, a permanent committee of thirty-two members to be chosen from among the Legislative Assembly, the higher public instruction (professors of universities), the Imperial Conservatory of Arts and Works, the Committee of Arts and Manufactures, the heads of great industrial establishments, the free public instruction, and the Administration (Préfets, Maires, &c.). A sum of £20,000 has been granted to the Minister aforesaid, for the purpose of encouraging technical education; and the committee just alluded to will have to aid and advise the Minister and other parties in the carrying out of a good and useful technical instruction.

**A New Aspirator.**—Dr. Bleekrode.—This paper is illustrated with a woodcut, absolutely required for the description of a very useful piece of apparatus, which can be readily made with the ordinary appliances at hand in any laboratory, and is so contrived as to admit of permanent action if desired.

*Cosmos*, March 26, 1870.

**Relation between the Variations of the Barometer and those of the Thermometer.**—H. H. Hildebrandsson.—A meteorological paper of some importance.

**Origin of Petroleum.**—V. Meunier.—Three theories exist on this subject, viz.—That the petroleum is the result of the distillation of coal situated within reach of sources of heat of volcanic origin; that it is the result of a peculiar decomposition of substances of animal and vegetable origin; and that petroleum owes its origin to volcanic emanations condensed by pressure and cooling of the superincumbent layers of rock and earths. According (says the author) to researches recently made, it is probable that, since there undoubtedly exists some relation between the deposits of sulphur, petroleum, and rock-salt, the origin of petroleum is due to volcanic agency.

**Intended Journey of Russian Scientific Men to the Western Portion of Europe.**—A committee of the following gentlemen are preparing for a journey through Germany, France, the United Kingdom, and other parts of Europe, for the purpose of studying the progress made by science in all its branches in Western Europe:—Profs. Chrouszewsky, Kowalewsky, and Hibel, of Kiew University; the Grand Master of Dorpat University, Dr. M. Kepen; Profs. Prachoff and Baraniecky, of St. Petersburg University; Prof. Sobler, of Moscow University; Profs. Wladiniwoff and Kolossoff, of Charkoff University; Dr. Brandt, of St. Petersburg, and Dr. He, of Kasan University.

*Zeitschrift für Analytische Chemie*, Nos. 3 and 4, 1869.

The publisher of this periodical informs us that a strike of long duration among compositors and pressmen in a portion of Central Germany has caused a delay of several months in the issuing of this periodical, of which the two numbers now before us (a volume of some 300 pages) contain the following original memoirs and papers:—

**Collocation of the Specific Gravities of Aqueous Solutions.**—Dr. G. T. Gerlach.—This very useful tabulated form is arranged in the following manner:—At the top of the pages, divided into nine columns, we find, under the figures A, B, C, &c., to I, inclusive—The chemical formula and the equivalent of the substance in solution, in anhydrous as well as in hydrated or crystallo-hydrated state; quantities by weight of the hydrated substance contained in 100 parts of the solution; quantities by weight of the anhydrous substance in 100 parts of the solution; atoms of the anhydrous salt + 100 parts of water by weight; relative volume (bulk) of the solutions, taking the 100 parts by weight of water used for solution = 100 volumes; specific gravity of the solution; volumetrical degrees according to Gay-Lussac; name of the experimenter; temperature, and quotation of the book or periodical where the results here collected have been originally published. As regards the substances here named, they are—Caustic ammonia; caustic potassa and soda; the carbonates of the two last-named bases; chloride of ammonium; chloride of potassium; chloride of sodium; chloride of aluminium; chloride of magnesium; chloride of calcium; chloride of strontium; chloride of barium; chloride of cadmium; chloride of zinc; chloride of tin ( $\text{SnCl}_2$ ); perchloride of tin; the bromides of potassium, sodium, lithium, magnesium, calcium, strontium, barium, cadmium, zinc; the iodides of potassium, sodium, lithium, magnesium, calcium, strontium, barium, cadmium, zinc; hyposulphites of soda; the sulphates of ammonia, potassa, soda; protoxide of manganese; protoxide of iron; protoxide of iron and ammonia; sulphates of magnesia and potassa ( $\text{KO} \cdot \text{SO}_3 + \text{MgOSO}_3 + 6\text{HO}$ ); sulphate of zinc; of copper; neutral and bichromate of potassa; neutral phosphate of soda; basic phosphate of soda; neutral arseniate of soda,  $2\text{NaOH} + \text{AsO}_5 + 24\text{HO}$ ; basic arseniate of soda,  $3\text{NaO} \cdot \text{AsO}_5 + 24\text{HO}$ ; the nitrates of potassa, soda, magnesia, strontia, baryta; oxide of lead; chlorate of potassa; bromates of potassa and soda; iodates of potassa and soda; ferrocyanide of potassium and ferricyanide of potassium; neutral acetate of lead; neutral tartrate of potassa ( $\text{KO} \cdot \text{T}$ ); neutral tartrate of soda; tartarus natronatus; tartrate of potassa and soda; hydrochloric acid ( $\text{ClH}$ ); sulphuric acid; sulphurous acid; phosphoric acid; arsenic acid; nitric acid; acetic acid; tartaric acid; citric acid. The paper further contains the following sections:—The legal (gesetzmässig) continuation of the specific gravities of equally-concentrated solutions; changes of bulk which take place during the solution of salts; changes of bulk which take place when aqueous solutions of salts are diluted with water; changes of bulk which take place when different solutions of salts are mixed. There follows next a series of tabulated forms, containing—(1) The specific gravities of almost all hitherto-investigated aqueous solutions of salts, of caustic alkalies, of acids, and of sugar and alcohol. We cannot enter into more details, but should think that, since the portion of text to be translated is very small, these tables might be very usefully published in English in a separate volume, since the collection is highly useful, not only to scientific men, but also to very many manufacturers.

**Contribution to the Means of Detecting, and Characteristic Reactions of, Citric Acid.**—H. Kæmmerer.—Since the value of this paper rests entirely upon the woodcuts annexed thereto, representing microscopically-observed substances, we cannot enter into any further details.

**Reciprocal Method of Calculating Atomic Formulæ, and especially those of Silicates.**—Dr. Mohr.—This paper cannot be read without the re-production of a series of tabulated forms belonging to it.

**Contribution to the Methods of Analysing Mineral-Water.**—Dr. Mohr.—A short paper. Reserved for full translation.

**On R. Wagner's Chlorometrical Method.**—Dr. Mohr.—A reply to Dr. R. Wagner, who thinks that the author's criticisms on his



(Wagner's) method, as published by the author in his celebrated work on volumetrical analysis, are based on erroneous views.

**Analysis of Manganese.**—Dr. Mohr.—A short but valuable paper. Reserved for full translation.

**Presence of Peroxide of Hydrogen in Air.**—H. Struve.—The chief results contained in this paper are—(1) Peroxide of hydrogen is formed in the air simultaneously with ozone and nitrate of ammonia, and is condensed in the meteoric waters; (2) peroxide of hydrogen, ozone, and nitrate of ammonia, are intimately connected together; (3) the change which the so-called ozone-paper undergoes when exposed to air is due to the joint action of ozone and peroxide of hydrogen; (4) peroxide of hydrogen does not decompose solution of iodide of potassium with separation of free iodine; (5) free carbonic acid decomposes the solution of iodide of potassium, causing the formation of carbonate of potassa and free hydriodic acid; (6) when the peroxide of hydrogen is present along with carbonic acid (acting as just alluded to), iodine is separated; (7) the best and most effective reagent for the detection of small traces of peroxide of hydrogen is oxide of lead, since puce-coloured peroxide is formed. The author describes at great length the reactions and the proper application of the same.

[The further contents of this publication are unavoidably postponed till next week.]

## NOTES AND QUERIES.

**Glycerine.**—It will be a favour if you can inform me of a good test, or tests, to ascertain the commercial value of glycerine, and that it has not been adulterated with glucose or other matter.—SUBSCRIBER.

**Volatilising Common Salt.**—Would any of your readers kindly inform me of the best means of volatilising common salt? Must superheated steam be driven through it, or will an extreme heat be all that is necessary?—ENQUIRER.

**Dinitrobenzol.**—I shall be glad if any of your correspondents can tell me of a better process for making this substance than those given in "Watts" and "Miller." I have tried them and have not succeeded in making it.—W. H. W.

**Liq. Ammonia.**—(Reply to J. Spencer.)—You can find the description of the apparatus you want in the work on Technology, published by M. Baillière, and edited by Dr. Richardson and Mr. Watts. The work may be inspected at the Library of the Commissioners of Patents. Our space is too limited to describe the apparatus here.

**Dr. Schiebler's Apparatus.**—(Reply to W. R.)—When the earlier portion of my notes were prepared the fifth edition of "Fresenius" was not published—the publication being almost simultaneous with the appearance of my first paper. For general description of apparatus consult "Fresenius" (4th edition, p. 711). The apparatus I work with was purchased in Berlin, but is, I think, supplied by Dr. Schiebler, Stettin, for 20 Thalers (about £3), complete. It is applicable for all carbonates where carbonic dioxide is the only gas evolved.—W. ARNOT.

**Alumina.**—(Reply to Arthur Warner.)—Wavellite is not, as you suppose, a native alumina, but the native phosphate of that base. Whether or not any pure native hydrate of alumina occurs in Cornwall, we are not now prepared to say. Under the name of bauxite, a native hydrate of alumina of great purity occurs in the south of France. Kaolin, after thorough calcination, may be made to yield, by treating it with boiling sulphuric acid (sp. gr., 1.384), very pure sulphate of alumina (alum cake); and kaolin is abundantly found in Cornwall. On perusal of our advertising columns, you will find that pure alumina is advertised for sale.

**Removing Silica.**—(Reply to W. H.)—The silica is present in the carbonate of potassa chiefly as a silicate; and it is stated in the *Handwörterbuch der reinen und ange Wandten Chemie* that digestion of this salt with pulverised charcoal will decompose the silicate. Your best plan, however, is, since it appears that you have to deal with a very crude material, to dissolve it in three-fourths of its weight of cold water, and, after decantation of the solution, leave the residue exposed to air, the carbonic acid of which slowly decomposes the silicate. The aqueous solution obtained should be evaporated to dryness, when it will yield a pretty pure carbonate of potassa.

**To Purify Methylated Spirit.**—(Reply to "Bichromate.")—Arrange an apparatus as for the continuous distillation of ether, but let the proportion of sulphuric acid be less than is necessary for etherification. Probably there is but little destruction of methyl, but the effect is very materially to sweeten the filthy compound. The distillate is acid, and must be drawn over again, after digestion with carb. of potassa.—R. T. CLARKE.

**Dissolving Cellulose.**—(Reply to "Bichromate.")—It appears, from the researches of M. Persoz, jun., that the easiest plan for preparing a very active ammonio-cupric solution is to cause strong liquid ammonia to act upon a piece of copper with contact of air, briefly to stir strong liquid ammonia with a piece of copper, until the fluid, of which, now and then, a small sample may be taken for testing, dissolves cotton readily in the cold; wool is insoluble in this fluid in the cold, but is readily dissolved when heat is applied. Chloride of zinc solution of a sp. gr. of 1.718 dissolves silk slowly in the cold, rapidly by application of heat (see, on this subject, J. Persoz's paper in the *Comptes Rendus*, vol. lv., p. 810 (1862), which you can peruse at the Patent Office Library). As to a cheap method of destroying the smell of methylated spirits, you might try re-distillation, after having left the fluid in contact for some time with some quick-lime and well-burned charcoal.

**Hardness of Water, &c.**—I shall be favoured by an explanation of this anomaly in testing the hardness of water by Clark's standard. Supposing a water requires 32 soap tests to produce a permanent lather for five minutes; such would be called of 16° hardness. Take another water, requiring, say, 34 soap-tests, the hardness of which would be, by the scale, 15 and 4-10ths degrees. Thus—2-34ths degrees = 17 and 17 soap-tests = 7 and 7-10ths degrees, which, multiplied by 2, = 15 and 4-10ths degrees, being actually less than a water requiring but 32 soap-tests, whereas we know that such water would really be harder than the first example! And, query, is the native sulphate, selenite, or the artificial chloride of calcium, preferable as a standard solution?—W. R.

**Baumé's Hydrometer.**—(Reply to J. T. E.)—You cannot certainly use this hydrometer (better, areometer) for determining the specific gravity of glass. If you want to know that, you could use Nicholson's hydrometer, with weights, which is an instrument made of brass, and sold by instrument makers; or you may determine the sp. gr. of the glass by the well-known methods described in books on natural philosophy. The specific gravity of the glass the hydrometers are made of, whether graduated according to Twaddle's, Baumé's, Beck's, or any other scale, has nothing to do with the instrument as constructed for use; but very frequently the instruments sold are not very well constructed, and mutually differ as to their indications, even at the same temperature. The average sp. gr. of glass varies, according to its composition, from 2.64 to 3.77.—NEMO.

**Caustic Soda and Lime.**—Perhaps some of your readers will explain the following, as I do not find anything relating to it in any work I have at hand:—Having occasion to use caustic soda in considerable quantities, and finding that unless sufficient lime has been used to decompose the whole of the carbonate of soda, it does not answer my purpose, and wishing to have some means of ascertaining this readily, I thought lime-water might answer on the supposition that if the soda solution contained carbonate of soda the lime would be precipitated as carbonate of lime. I tried several samples with it, each of which produced a white precipitate. I then tried the purest caustic soda I could get at in Manchester, with the same result. I afterwards diluted a sample of commercial caustic soda to sp. gr. 1.075, and added lime-water so long as any precipitate was formed, then filtered it, and concentrated the clear liquor quickly to about 1.070 sp. gr.; on again adding lime-water to this, the lime was precipitated as before. What I wish to know is whether I am right in inferring that in each case the precipitate was caused by the presence of carbonic acid, and taking that for granted, how is it (as in the instance given) that the solution which would not give any further precipitate should, on concentration, again have that property. Would it be owing to carbonic acid absorbed from the atmosphere?—ENQUIRER.

## MEETINGS FOR THE WEEK.

MONDAY, April 4th.—Medical, 8.

— London Institution, 4.

— Royal Institution, 2. General Monthly Meeting.

TUESDAY, 5th.—Royal Institution, 3. Prof. Rolleston, on "Nervous System."

— Institution of Civil Engineers, 8.

WEDNESDAY, 6th.—Society of Arts, 8.

— Pharmaceutical, 8.

THURSDAY, 7th.—Royal Institution, 3. Prof. Odling, "Chemistry of Vegetable Products."

— London Institution, 7.30.

— Royal, 8.30.

— Royal Society Club, 6.

— Chemical, 8. Dr. John Hunter, "On the Analysis of Deep-Sea Water." Dr. J. H. Gladstone, "On the Refraction Equivalents of the Aromatic Hydrocarbons and their Derivatives." Prof. How, "On an Acid Feed-Water from the Coal-Fields of Stollaston, N.S., and the Results of its Use."

FRIDAY, 8th.—Royal Institution, 8. Prof. Huxley, "Pedigree of the Horse."

— Astronomical, 8.

— Quekett Microscopical Club, 8.

SATURDAY, 9th.—Royal Institution, 3. Mr. Lockyer, "The Sun."

## TO CORRESPONDENTS.

W. R.—Your first letter was in type when your second letter arrived.

Alcohol.—Full directions for the preparation of hydrate of chloral have already appeared in our columns.

J. C. M.—You had better advertise.

W. Arnot.—Received. Many thanks for the trouble you have taken in the matter.

R. W.—Our advertisement-sheet is the proper medium for making your wants known. We can only insert replies to queries which are likely to be useful to our general readers.

A Reader, Redditch.—Consult "Cooley's Cyclopædia of Practical Receipts," published by Churchill.



# THE CHEMICAL NEWS.

VOL. XXI. No. 541.

## ON THE LIGNITES OF MIDDLE AND SOUTHERN ITALY.\*

By AUGUSTUS A. HAYES, M.D.,  
State Assayer of Massachusetts.

SINCE the independence of the Free States of Italy was achieved, scientific explorations have shown the existence of various and considerable natural resources, which may become of great national importance to that country. Among these are numerous deposits of lignite and bitumens; and even sources of mineral oils have been found.

Professor Carlo Cassola, of Naples, one of the most active scientific men of that country, has influenced the present Government so far that aid in the collection of specimens from various localities has been secured; and the parcels sent to Naples now form a large aggregate in the extensive laboratory and museum in charge of Professor Cassola.

Through the kindness of the Professor, I was allowed to examine and analyse some of these samples; and I also visited one of the deposits, a few miles distant from Benevento, in company with himself, scientific friends, and representatives of the Government.

The lignites are found in a formation which represents the tertiary of this country. Clay, conglomerate, and decomposing schists were the immediate enclosing rocks of this locality, and the beds had evidently been broken up and moved from position of deposition by superficial changes.

Some of the lignites presented the varieties of brown coal, with more or less of woody structure visible, and they differed in power of retaining moisture, in gravity, colour, and compactness. One variety was remarkable, inasmuch as it so closely resembled Cannel coal in appearance and general physical characters as to be easily taken for Cannel. It requires, indeed, careful examination to enable one to distinguish it from Cannel; and, as seen, it promised to prove an excellent fuel.

I engaged in the chemical analysis of the Cannel-like variety with great interest, and soon found it to differ remarkably from ordinary lignite, in containing a large proportion of combined water, which was retained after long exposure to a high temperature; indeed, some samples afforded water at 600° F., and the point of complete desiccation did not vary more than 50° F. from the point of temperature necessary to cause decomposition.

An air-dried, selected, average sample of the Cannel-like variety afforded—

Moisture, as given off at 100° to 110° C.	3.40
Water, lost in air at 200° to 230° C. ..	18.20
Volatile combustible matter .. ..	29.80
Solid carbon, as compact coke .. ..	43.60
Greyish-white ash .. ..	5.00
	100.00

The above composition does not express a valuable fuel; and other samples contain, not only more combined water, but earthy substances also, which would appear as ash in large amount. Indeed, the varieties of these

minerals found in Southern Italy, when compared with good laminated coal, as fuel or as a source of power, did not warrant the belief that they can replace coal.

This is a subject of vital importance to a nation wishing to maintain steam-ships upon the ocean, or to carry on those operations in which fuel is an essential element of aid; and every well-wisher of Italy will be interested in the effort now put forth in the search of coal, and in devising substitutes for this mineral suitable for consumption on ship-board. There is much of newly-awakened enterprise and activity of mental ability in free Italy, and the sources of physical well-being and progress were never more carefully scanned in all directions.

In connection with the subject of fuel, it was a happy suggestion of Professor Cassola that led to the mode in which these lignites and hydrous fuels may be burned with advantage. He proposed to mix or saturate the porous lignites with the crude natural bitumens, and burn the nearly-dry artificial mixture thus made as coal, in any ordinary stove or fire-place, on ship-board or in work-shops.

The lignites readily absorbed about 20 per cent of the semi-fluid hydrocarbon; and the result was not adhesive, and could be quite as comfortably handled as softer varieties of coal. This mixture, by estimation, had a high practical value, and presented the utilisation of crude petroleum as fuel under a new and inviting aspect.

The burning of any kind of fluid hydrocarbon which can be converted into oils as fuel must be regarded always as a misapplication of a valuable natural production. With this conviction, I had witnessed the experiments made on board a gun-boat of our own Navy, where much invention of a high character had solved the problems and overcome the obstacles presented in burning completely. Yet, unless in other applications the crude material has little value, it can never compete with coal economically.

The bitumens of Southern Italy resemble those of California generally, though their petroleum-oil has been drawn from tolerably-deep wells; and the latter are, therefore, adapted to this new use, becoming valuable, not as fuel *per se*, but in conferring on a poor hydrous-combustible a greatly-increased power in producing heat.

This suggestion of the Professor at once led to application on a useful scale. The Government placed a steamship in order for comparative trials of the new fuel (that is, average lignite which had absorbed about one-fifth of its weight of dark, semi-fluid bitumen, and become nearly dry), and, on the other hand, the best English steam-coal supplied to the Navy, were used in equal weights in producing steam-power. Engagements prevented me from witnessing the trials; but the Admiral's report, expressing the practical results of propelling the ship from point to point of equal distances, gave for the new fuel a value at least equal to that of the best coal, for naval purposes. The mixed fuel, in the trials, was burned in the ordinary coal-furnaces, and did not produce smoke.

This application of Professor Cassola becomes of great importance, therefore, if subsequent search shall show that Italy possesses large deposits of lignite and bitumens; and this mode of utilising hydrous lignites carries with it those practical features which recommend its adoption wherever hydrous fuels and bitumens can meet as products of small value on the spot.

In California, where semi-fluid bitumens exist, the increasing facilities for transportation may allow the value of lignites of that and other states to be greatly increased by the absorption of bitumen, so as to form an artificial fuel in which the combined water of the lignite will be utilised to form a strongly-heating flame in the otherwise smoke-producing vapours of the bitumen.

\* From the *American Gas-Light Journal*. Communicated by the Author to the CHEMICAL NEWS.



## ON MICROSCOPICAL MANIPULATION.

By W. T. SUFFOLK, F.R.M.S.

(Continued from p. 150).

## LESSON VI.

*Fibres used in the Manufacture of Clothing, and Analysis of Textile Fabrics.*

THE materials of textile manufactures may be divided into four classes, two of which are derived from the vegetable and two from the animal kingdom.

The vegetable fibres consist either of hairs or liber cells, a tissue resembling woody fibre.

Of hairs, only those covering the seeds of several species of *Gossypium* (a genus of malvaceous plants) are used in commerce, and are known as *cotton*.

The liber cells are supplied from many sources, and are used for a great variety of purposes, every kind of fabric, from fine linen to cordage, being made from them.

Familiar examples are flax (*Linum usatissimum*), jute (*Corchorus capsularis*), hemp (*Cannabis sativa*), China-grass or rhea (*Bœhmeria nivea*).

The animal materials consist of silk, an albuminous fibre produced by various catapillars.

The remaining class comprises the hairs of those animals which are capable of being either spun or felted—such as wool and its varieties, as alpaca, &c., hairs of rabbit, beaver, &c.

*Specimens Required.*—Fibres of cotton, flax, hemp, silk, and wool; pieces of calico, muslin, linen, silk, flannel or blanket, and any other woven fabrics and threads procurable; also hairs of various animals.

Examine fibres of cotton, flax, hemp, silk, and wool, as described in Lessons I. and II., with  $O_1$  or  $O_2$ , on stage-plate, by reflected light.

Notice the differences of structure. *Cotton* consists of flattened, twisted fibres. *Flax* and *hemp* are rounded, with more or less apparent transverse markings. *Silk* is conspicuous for the absence of all structural peculiarities. *Wool* exhibits a circular fibre, with delicate markings.

It will be seen that the four classes of fibres have all well-marked characters, and can be readily distinguished from each other under the microscope.

Mount specimens of all the fibres collected, by dry process (vol. xx., p. 193), taking care, as fibrous tissues are very hygroscopic, that they are properly dried. As they will bear a heat not exceeding that of boiling water without injury, the ether process will not be required. Label, and preserve for future reference. Place, also, a small portion of the fibres of cotton, flax, and hemp in separate bottles, with saturated solution of chloride of calcium; leave them to soak for a few days, and then mount in same fluid, taking the precaution to separate the fibres by tearing them apart with needles, so that the single fibres may be well displayed before closing the cell. The silk and wool should be mounted dry, and also in balsam, with as little heat as possible, if transparent specimens are required.

As the mountings in chloride of calcium will be some days in hand, unless the air-pump is used, prepare portions of cotton and flax, on slides, with turpentine, which will render the fibres transparent; and examine with a power of not less than  $O_2$  ( $O_4$  will be better), with polarised light, using achro-

matic condenser and eye-piece analyser (vol. xxi., p. 8). If the condenser is not accessible, the intensity of the illumination may be greatly increased by concentrating the light of the lamp on the concave mirror with the condensing-lens.

The *cotton* will display more or less colour, indicating doubly-refractive properties, but no very marked structural peculiarities. The *flax* will show a vast amount of structure. The transverse markings seen by reflected light will become more conspicuous, and other markings of a more or less spiral nature will, with proper adjustment of the selenites (vol. xxi., p. 9), be rendered visible. These consist of thickenings of the cell wall, known as secondary deposits, and are easily seen by polarised light, owing to their doubly-refractive power differing from that of the thinner portions of the tissue; while, by ordinary transmitted light, they would have been nearly invisible, owing to their transparency. It is much easier to distinguish the fibres of cotton and flax in a mixed fabric by observations with polarised light than by any other means. A power of  $O_1$  is quite sufficient when merely the presence of cotton on flax has to be determined.

A careful series of observations on liber cells is much wanted. At present, it is difficult to distinguish between flax and hemp, and other fibres of the same class, so that they might be detected with certainty in mixed fabrics. The chief impediment consists in the very close resemblance of all these fibres to each other. It is, in general, much easier to distinguish them in mass, by various peculiarities of colour, texture, &c., than by the most careful microscopical examination of single fibres.

The action of dyes might reveal some peculiarities connected with these tissues. Experiments on cotton have been tried by Mr. W. Crum, of Manchester. Transverse sections\* have been examined by a Continental observer, and, although somewhat difficult to obtain, might be studied with advantage. The whole subject is much in need of investigation.

Woody fibres are used occasionally for purposes of adulteration; an instance is mentioned under silk. A curious case came under the author's notice, in which cotton wick, intended for the manufacture of composite candles, was adulterated with a small quantity (about 5 per cent) of some undetermined liber fibre. Trivial as was the amount of this admixture, it entirely unfitted the wick for the purpose for which it was intended, causing it to remain unconsumed, and accumulate, instead of bending over to the outer part of the flame, and burning away.

For account of liber cells, see—Bentley's "Manual of Botany," p. 30; article, *Liber*, "Micrographic Dictionary," p. 417; *Science Gossip*, vol. ii., p. 10.

(To be continued.)

**Andersonian University.**—We believe that Dr. Clark, assistant to the late Dr. Penny, who delivered the remainder of the winter course of lectures on Chemistry after that gentleman's death, has been appointed to deliver the summer course; pending permanent arrangements consequent upon the proposal of the President, Mr. Young, to endow a chair of technical chemistry.

\* Fibres, hairs, and other long thin substances of which sections are required should be made up into bundles with weak glue, and cut into thin slices with a sharp razor; the sections can be liberated by dissolving the gelatine in hot water.



## PROCEEDINGS OF SOCIETIES.

### CHEMICAL SOCIETY.

*Anniversary Meeting, March 30th, 1870.*

Dr. A. W. WILLIAMSON, F.R.S., &c., President, in the Chair.

THE following Officers have been elected for the ensuing year:—

*President*—A. W. Williamson, Ph.D., F.R.S.

*Vice-Presidents who have filled the office of President*—Sir B. C. Brodie, F.R.S.; Warren De la Rue, Ph.D., F.R.S.; A. W. Hofmann, D.C.L., F.R.S.; W. A. Miller, M.D., D.C.L., F.R.S.; Lyon Playfair, Ph.D., C.B., F.R.S.; Col. P. Yorke, F.R.S.

*Vice-Presidents*—J. H. Gilbert, Ph.D., F.R.S.; E. Frankland, Ph.D., F.R.S.; A. Mattheissen, Ph.D., F.R.S.; H. M. Noad, Ph.D., F.R.S.; W. Odling, M.B., F.R.S.; T. Redwood, Ph.D.

*Secretaries*—A. Vernon Harcourt, M.A., F.R.S.; W. H. Perkin, F.R.S.

*Foreign Secretary*—H. Müller, Ph.D., F.R.S.

*Treasurer*—F. A. Abel, F.R.S.

*Ordinary Members of the Council*—E. Atkinson, Ph.D.; H. Bassett; E. T. Chapman; F. Field, F.R.S.; David Forbes, F.R.S.; M. Holzmänn, Ph.D.; E. J. Mills, D.Sc.; W. J. Russell, Ph.D.; Maxwell Simpson, Ph.D., F.R.S.; R. Angus Smith, Ph.D., F.R.S.; John Tyndall, LL.D., F.R.S.; A. Voelcker, Ph.D.

After having communicated to the Fellows the above list, the President delivered the following address:—

Gentlemen,—On behalf of the Council, I feel very great pleasure in congratulating you on the rapidly-increasing usefulness and prosperity of our Society.

The most interesting incident in the history of the past year has been the delivery by M. Dumas of the Inaugural Faraday Lecture. It was indeed an impressive tribute to the memory of our great countryman which was paid by that noble veteran of science, and one of which the record ought to occupy a place of honour in our Journal. We still hope to receive from M. Dumas a manuscript of his classical discourse.

The Council have had the pleasure of accepting the offer of a munificent donation of palladium from Messrs. Johnson and Matthey, to be used for the preparation of the first ten Faraday medals.

Your Council have felt it to be of considerable importance to give greater publicity to the proceedings of the Society, and they have accordingly made provisional arrangements for the preparation of abstracts of the papers, and, in some cases, of the discussions, for transmission to such papers as desire to publish them. These abstracts already appear in several papers, and are read with interest.

At the time of the last Anniversary Meeting, the Society numbered 522 Fellows. Since that time, 41 new Fellows have been elected, and have paid their admission-fees. On the other hand, six Fellows have been removed for non-payment of fees, one Member (Mr. A. W. Gillman) has withdrawn from the Society, and we have lost five by death. The present number of Fellows is accordingly 551.

The number of Foreign Members at the time of our last Anniversary Meeting was thirty-eight, but of these we have to deplore the death of two, viz., Dr. Otto Linné Erdmann, Leipzig, and Dr. Joseph Redtenbacher, Vienna; so that we now count only thirty-six Foreign Members.

The names of the Fellows who have died during the past year are:—Thomas Graham, Sept. 16th; T. Penny Nov. 22nd; A. B. Northcote, Dec. 28th; E. N. Brayley, Feb.; and I have this morning received intelligence of the death of Julian Courtauld and T. L. Wheeler.

Thomas Graham died September 16th, at his house, 4, Gordon Square.

From an early age, Graham's one great object of life was the discovery of new truths, and he appreciated so fully the value of such work that he resolved to make any personal sacrifices which might be needed for its sake. And nobly he kept his resolution; for, at an early stage of his career, he endured, for the sake of pursuing chemistry, privations and sufferings so severe that they are believed to have permanently injured his constitution; and, at its very end, long after he had attained a world-wide reputation, when his delicate frame sorely needed the repose which was at his command, he continued to labour even more effectively than before, and to enrich science with new discoveries.

It might be difficult to find in history a character so perfect in its noble simplicity and elevation.

Graham was born at Glasgow, on December 21st, 1805, the eldest of a family of seven, of whom only one survives.

He went to the English Preparatory School at Glasgow in 1811, and was there under the care of Dr. Angus. In the year 1814, he was removed to the High School, where, for four years, his studies (which included the Latin language) were directed by Dr. Dymock, and subsequently for one year by the Rector, Dr. Chrystal, under whom he studied Greek. It is said that during these five years he was not once absent at school-time. In 1819, he commenced attendance in the University classes in Glasgow.

Thomas Thomson then occupied the Chair of Chemistry, and young Graham benefitted by his instruction, as, also, by that of Dr. Meikleham, the Professor of Natural Philosophy.

By this time he had already acquired a strong taste for experimental science, and formed a wish to devote himself to chemistry. His father, an able and successful manufacturer, had formed different views for his future career, and wished him to become a minister of the Scotch Church. It is hardly to be wondered at that the father should not have seen in the prosecution of science much scope for an honourable or advantageous career; but young Graham had already seen something of the means afforded by experimental science of getting knowledge from the fountain-head—from Nature herself. He felt the need of more such knowledge to mankind, and his scheme of life was formed accordingly.

After taking the degree of M.A. at Glasgow, he continued his studies for two years at Edinburgh, and there studied under Dr. Hope, and enjoyed the friendship of Professor Leslie. On his return to Glasgow, he taught mathematics for some time, at the suggestion and under the patronage of Dr. Meikleham, and subsequently opened a laboratory, in Portland Street, Glasgow, where he taught chemistry. It is probable that some of the severest trials of his life occurred at about this period.

While absent from Glasgow, he was in the habit of writing regularly and at great length to his mother; and, from the tenour of these letters, it is easy to see what that mother must have been to him. A writer on the social position of women has described the feelings of boys towards their mothers as scarcely amounting to respect! Young Graham's mother seems to have been his guardian-angel, sympathising with his hopes and his sorrows; and certainly his feelings towards her would have been very inadequately described by that frigid word. While studying at Edinburgh, he earned, for the first time in his life, some money, by literary work, and the whole sum (£6) was expended in presents to his mother and sisters.

In 1829, he was appointed Lecturer on Chemistry at the Mechanics' Institution, Glasgow, in place of Dr. Clarke; but the decisive step of his life was in the subsequent year. It was in 1830 that he was appointed Professor of Chemistry at the Andersonian University, Glasgow; and it is said that his mother, who was on her deathbed, lived to hear the glad tidings of his appointment.

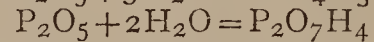
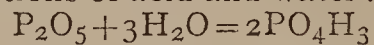


He was now more favourably circumstanced for experimental labours; and we find that the seven years spent at the Andersonian University were years of great activity.

In the beginning of the year 1837 died Edward Turner, Professor of Chemistry in the newly-founded London University, now called University College, London. Thomas Graham was the successful candidate for the vacant chair, and in August of the same year we find him already settled in the great metropolis. It was only now that the young philosopher found adequate scope for his abilities. Young men thirsting for knowledge crowded to his lectures, and in those lectures he explained the principles of chemical science with an exactness and clearness never before attained. The success of these lectures was not due to eloquence, nor to any smoothness of diction, for all such matters Graham usually neglected to a degree which in an ordinary person would hardly have been excused. He had a truly philosophical method, which carried away the listener with irresistible force,—the same exactness of thought, the same logical arrangement of matter—in a word, the same purely scientific mind which pervades his work “The Elements of Chemistry.” That work which immediately made its author's name known in all parts of the world is too well known to the Fellows of the Chemical Society for it to be necessary to speak here of its great merits. I will merely allude to the successive editions which have appeared in England, the numerous reprints scattered about America, and the translations published in many languages. In Germany, the excellent edition of Fr. Tul. Otto is still the most extensively used and the most valued book of chemical instruction.

Of Graham's investigations that on the phosphates is remarkable in many ways. It was known that solutions of phosphoric acid in water vary in their properties; and chemists were satisfied with giving a name to the changes without investigating their nature. These solutions contained phosphoric acid and water, and were assumed to have like composition. They were accordingly called isomeric. Graham observed that they differ from one another in the proportion of water combined with the acid, and constitute in reality different compounds.

He knew that water combines with acids as other bases do, and he showed that the various compounds of phosphoric acid and water constitute distinct salts, each of which admits of its hydrogen being replaced by other metals without disturbance of what we should now call the type. Thus, to use our present notation, the three hydrates  $\text{PO}_4\text{H}_3$ ,  $\text{P}_2\text{O}_7\text{H}_4$ ,  $\text{PO}_3\text{H}$ , correspond to the following proportions of acid and water:—



Graham observed that the hydrate  $\text{PO}_4\text{H}_3$  is constituted like a salt, inasmuch as its hydrogen can be replaced atom for atom by other metals, like sodium, potassium, &c., forming such compounds as  $\text{PO}_4\text{NaH}_2$ ,  $\text{PO}_4\text{Na}_2\text{H}$ , &c.

In order to appreciate duly the powers of mind of the author of this admirable research, we ought to compare his methods of reasoning with those generally prevalent among contemporary chemists, and, on the other hand, with the methods of to-day. One would fancy that Graham had been acquainted with the modern doctrines of types and of polybasic acids, so clearly does he describe the chemical changes in matter-of-fact language, and so consistently does he classify the compounds by their analogies. At that early period we find Graham considering hydrogen, in various salts, as a basylous metal; an idea which, in spite of its undeniable truth, some chemists of the present day have not fully realised.

Amongst minor chemical researches, may be mentioned a series of experiments on the slow oxidation of phosphorus by atmospheric air. He discovered that this process (and the faint light which accompanies it) is arrested by the presence in the air of a trace of olefiant gas, 1-450th of the volume of the air being sufficient for

the purpose. Still smaller proportions of some other vapours were found capable of producing this same effect; spirits of turpentine being particularly remarkable, as less than a quarter of a thousandth of its vapour with air was found sufficient to prevent the slow oxidation of phosphorus.

On another occasion Graham investigated phosphuretted hydrogen, and made some remarkable observations concerning the conditions of the formation of the spontaneously inflammable gas. One of these deserves especial notice in connection with the action of olefiant gas, and in preventing the oxidation of phosphorus. He found that phosphuretted hydrogen is rendered spontaneously inflammable by the admixture of a very small proportion of an oxide of nitrogen, probably nitrous acid.

One of the most obscure classes of combinations are those which water forms with various salts. These bodies are characterised by the chief peculiarities which belong to definite chemical compounds; but chemists are, as yet, unable to explain them.

Water so combined is called water of crystallisation, and is said to be physically, not chemically, combined. A very convenient way of getting rid of a difficulty, by passing it on to our neighbours.

Graham examined the proportion of such water of crystallisation in a considerable number of salts, and he moreover examined the properties which it has when so combined. He found that some of the water in an important class of sulphates is held far more firmly than the remainder, and with force equal to that with which water is held in various chemical compounds. He showed that such firmly combined water can be replaced by salts in a definite chemical proportion. In fact, he got fairly hold of the subject by chemical methods, and laid the foundation for an explanation of it.

He discovered and examined compounds of alcohol with salts, and derived from them valuable evidence of the analogy between alcohol and water.

On a later occasion he made a series of important experiments upon the transformation of alcohol into ether and water, by the action of hydric sulphate. Liebig had endeavoured to explain the formation of ether in this process, by representing it as due to the decomposition at a high temperature of a compound of ether previously formed at a lower temperature; such decomposition being due to the increased tension of the vapour of ether at the higher temperature.

Graham justly argued that if the decomposition were due to the tension of ether vapour, it would not take place, and ether would not be formed, if the tension were not allowed to exert itself. He heated the materials in a closed tube, and proved that ether was formed, although the tension of its vapour was counteracted by the pressure thus obtained.

The line of research which occupied most of his attention, and in which his results were, perhaps, the most important, was that of diffusion; and it would be difficult to over-estimate the importance to molecular chemistry of his measurements of the relative velocities of these spontaneous motions of particles of matter, whether in the state of gas or in the liquid state.

It was known that one part by weight of hydrogen occupies the same volume as sixteen parts by weight of oxygen when measured at like temperature and under like pressure. Chemical investigations prove that these equal volumes of the two gases contain the same number of atoms. We also know that the atoms in such a gas are in rapid motion, and resist the pressure to which the gas is at any particular time exposed, by striking against the surface which presses them together with force equal to that which presses them together.

Thus a given volume of hydrogen is maintained against the atmospheric pressure by an energy of atomic motion, equal to that of the same volume of oxygen. Each atom of hydrogen accordingly exerts a mechanical energy equal to that of each atom of oxygen; but we have seen that



the hydrogen atom is much lighter than the oxygen atom, and accordingly it must move with much greater velocity than the oxygen atom.

Now Graham allowed hydrogen to escape through a very small hole in a plate of platinum; and allowed oxygen to escape under similar circumstances. He found that each hydrogen atom moves out four times as fast as each oxygen atom. His experiments were so arranged as to enable him to measure the relative velocities of certain motions of the atoms—motions not imparted to them by any peculiar or unnatural conditions, but belonging to them of necessity in their natural state. He found, moreover, that heat increases the velocity of these atomic motions, whilst increasing the force with which a given weight of the gas resists the atmospheric pressure.

He remained at University College till the year 1855, when he was appointed Master of the Mint, an office which Sir John Herschel had recently resigned. His illustrious friend, Hofmann, from whom I have already freely quoted, shall tell how he discharged these responsible duties.

"It would be difficult to picture the extensive activity which Graham exercised in the high office entrusted to him. The new Master of the Mint showed a circumspection, a mastery of details, an amount of industry and energy, and when occasion required an impartial severity, which astonished every one—more especially some of the officials of the Mint. Such requirements had not hitherto been made, nor such control exercised. A strong resistance was made to the plans of innovation and alteration of the new Master." The author of these lines, Hofmann, at that time held an office in connection with the Mint, and was, therefore, witness of Graham's struggles in his new position. "It was years before he gained a complete victory, and before he was able to return to his favourite study. But at last this longed for period came, and a series of happy years followed. Not an instant was lost. A convenient laboratory was fitted up in the official residence of the Master of the Mint, whose handsome rooms the simple and independent man never occupied, and there his old labours were resumed with greater zeal than ever. Some of Graham's most beautiful researches date from this period. They sprang from the pure love of science. Graham needed to earn no name or position. Both had long been his undisputed property. But the same earnest desire to study nature which in early youth had induced him to bear without murmurs the greatest privations and the bitterest sorrows, still animated him and armed him against the new dangers which threatened his scientific labours from the splendour of his official position and the distractions which it entailed on him."

The study of the condensation of gases by solids, and the combination of soluble compounds with membranes, led him to discoveries which are likely to be of great value to physiologists in explaining processes of absorption and secretion.

Thus he found that oxygen is absorbed to a greater extent than nitrogen by caoutchouc, and that when a bag made of a thin membrane of this substance is exhausted by means of a good air-pump, the oxygen and nitrogen diffuse through it (probably as condensed liquids), and evaporate inside the bag in different proportions from those in which they are present in air; the oxygen rising to over 40 per cent of the diffused air. Again, a mixture of hydrogen and oxygen was separated almost completely by the action of palladium, which condensed the hydrogen in very large quantity, and the oxygen very slightly.

Perhaps the most remarkable substances discovered in the course of his experiments on diffusion were the soluble modifications of tungstic and molybdic acids, ferric oxide, &c., and the process by which these bodies were obtained was, perhaps, the most instructive part of the result; proving, as it does, that in their salts, these bodies have properties different from those which they normally possess in the free state; and retain them when

the other constituent is removed by a sufficiently gentle process.

Another remarkable fact which bears on a most important theory, is the separation effected by Graham of potassic hydrate and hydric sulphate, by diffusion of potassic sulphate in aqueous solution—a fact which requires us to admit that the solution of the salt in water contains those products mixed with one another; just as much as the experiment of diffusing air through a porous clay pipe, and getting its constituent in a different proportion from that of the original air, proved that air is a mixture and not a compound of the two gases.

The phenomena of the diffusion of gases and liquids do not astonish us by their brilliancy and variety; but the immense importance of this region of experimental science dawns upon us when we remember that there is no so-called vital process which cannot ultimately be referred to a chemical process, that more or less intense chemical action takes place at all points of the frame of animals and plants, and that an essential condition of this action, and of life itself, is the carrying to and fro of materials, not only by muscular and ciliary action, but in a more intimate measure by diffusion.

In many of his ideas Graham was in advance of his contemporaries, and it might be difficult to find a chemist who has dealt more cautiously with general questions and delicate experimental operations,—or one whose results, in each direction in which he has worked, may more safely be expected to stand the test of future investigations.

The proceedings of the meeting terminated with a vote of thanks to the President for the able and effective manner in which he had discharged his official duties during the past year.

#### MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

*Ordinary Meeting, March 22nd, 1870.*

E. W. BINNEY, F.R.S., F.G.S., Vice-President, in the Chair.

THE following extract of a letter, dated March 21st, 1870, from Sir W. THOMSON, D.C.L., F.R.S., Hon. Member of the Society, to the President, was read:—

I have now, at last, got into good working-order measurements of electrostatic capacity (which, perhaps, you may remember I was working on the first time you ever came to see me, and more or less almost ever since). I have two students of last year, junior assistants in my laboratory, measuring electrostatic capacities of condensers, and variations of specific inductive capacities of resistance, with sensibility of 1-10th per cent, and with constancy, in spite of accidental variations, generally within  $\frac{1}{2}$  or  $\frac{1}{3}$  per cent.

My occupation on the kinetic theory of gases has led me, at last, to come to definite terms as to the size of molecules. Ever since about the first year of my Professorship, I have taught my students that Cauchy's theory of dispersion proves heterogeneousness, or molecular structure, to become sensible in contiguous portions of glass or water of dimensions moderately small in comparison with the wave-lengths of ordinary light. I have spoken to you also, I think, of the argument deducible from the contact-electricity of metals. This, I now find, proves a limit to the dimensions of the molecules in metals quite corresponding to that established for transparent solids and liquids by the dynamics of dispersion. In experiments made about ten years ago, of which a slight sketch is published in the *Proceedings of the Literary and Philosophical Society of Manchester*, I found that a plate of zinc and a plate of copper, kept in metallic connection with one another (by a fine wire or otherwise),



act electrically upon electrified bodies in their neighbourhood, and upon one another, as they would if they were of the same metal and kept at a difference of potentials equal to about three-quarters of that produced by a single cell of Daniell's. Hence, and from my measurement of the electrostatic effects of a Daniell's battery, published in the *Proceedings of the Royal Society* for February and April, 1860, I find that plates of zinc and copper, held parallel to one another at any distance ( $D$ ) apart which is a small fraction of the linear dimensions of their opposed surfaces, and kept in metallic communication with one another, exercise a mutual attraction equal to—

$$2 \times 10^{-10} \times \frac{A}{D^2} \text{ grms. weight.}$$

Hence, if they were allowed to approach from any greater distance ( $D'$ ) to the distance  $D$ , the work done by their mutual attraction is—

$$2 \times 10^{-10} \times \frac{A(D'-D)}{D'D} \text{ centimetre grms.;}$$

which, if  $D$  is very small in comparison with  $D'$ , is very approximately equal to—

$$2 \times 10^{-10} \times \frac{A}{D}$$

Now, suppose a pile to be made of a great number ( $N+1$ ) of very thin plates alternately of zinc and copper, kept in metallic connection while they are brought towards one another. Let their positions in the pile be parallel, with narrow spaces intervening. For simplicity, let the thickness of each metal plate and intervening space be  $D$ . The whole work done will be—

$$2 \times 10^{-10} \times N \frac{A}{D}$$

The whole mass of the pile, if we neglect that of one of the end plates, is  $NAD\rho$ , where  $\rho$  denotes the mean of the densities of zinc and copper. Hence, if  $h$  be the height to which the whole mass must be raised against a constant force equal to its weight at the earth's surface, to do the same amount of work, we have—

$$NAD\rho h = 2 \times 10^{-10} \times N \frac{A}{D}$$

which gives—

$$h = \frac{2 \times 10^{-10}}{\rho D^2}$$

or, as  $\rho = 8$ , nearly enough for the present rough estimate,

$$h = \frac{1}{(200000D)^2}$$

Hence, if—

$$D = 1\text{-}200,000\text{th centimetre,}$$

$$h = 1 \text{ centimetre.}$$

The amount of energy thus calculated is not so great as to afford any argument against the conclusion which general knowledge of divisibility, electric conductivity, and other properties of matter, indicates as probable—that, down to thicknesses of 1-200,000th of a centimetre for the metal plates and intervening spaces, the contact electrification, and the attraction due to it, follow with but little, if any, sensible deviation the laws proved by experiment for plates of measurable thickness with measurable intervals between them. But, let  $D$  be 1-200,000,000th of a centimetre: if the preceding formulæ were applicable to plates and spaces of this degree of thinness, we should have—

$$h = 1,000,000 \text{ centimetres, or 10 kilometres.}$$

The thermal equivalent of the work thus represented is about 248 times the quantity of heat required to warm the whole mass (composed of equal masses of zinc and copper) by  $1^\circ \text{C}$ . This is probably much more than the whole heat of combination of equal masses of zinc and copper melted together; for it is not probable that the compound metal, when dissolved in an acid, would show anything approaching to so great a deficiency in the heat

evolved below that evolved when the metallic constituents are separately dissolved,\* and their solutions mixed. But the experiment should be made. Without any such experiment, however, we may safely say that the fourfold amount of energy indicated by the preceding formula for a value of  $D$  yet twice as small is very much greater than any estimate which our present knowledge allows us to accept for the heat of combination of zinc and copper. For something much less than the thermal equivalent of that amount of energy would melt the zinc and copper; and, therefore, if in combining they generated by their mutual attraction any such amount of energy, a mixture of zinc and copper filings would rush into combination (as the ingredients of gunpowder do) on being heated enough in any small part of the whole mass to melt together there. Hence we may infer that the electric attraction between metallically-connected plates of zinc and copper of only 1-400,000,000th of a centimetre thickness, at a distance of only 1-400,000,000th of a centimetre asunder, must be greatly less than that calculated from the magnitude of the force and the law of its variation observed for plates of measurable thickness, at measurable distances asunder. In other words, plates of zinc and copper, so thin as 1-400,000,000th of a centimetre, and placed at as short a distance as 1-400,000,000th of a centimetre from one another, form a mixture closely approaching to a molecular combination, if, indeed, plates so thin could be made without splitting atoms.

Wishing to avoid complication, I have avoided hitherto noticing one important question as to the energy concerned in the electric attraction of metallically-connected plates of zinc and copper. Is there not a change of temperature in molecularly-thin strata of the two metals, adjoining to the opposed surfaces, when they are allowed to approach one another, analogous to the heat produced by the condensation of a gas, the changes of temperature produced by the application of stresses to elastic solids which you have investigated experimentally, and the cooling effect I have proved to be produced by drawing out a liquid film which I shall have to notice particularly below? Easy enough experiments on the contact-electricity of metals will answer this question. If the contact-difference diminishes as the temperature is raised, it will follow from the second law of thermodynamics (by reasoning precisely corresponding with that which I applied to the liquid film in my letters to you of February 2nd and February 3rd, 1858†) that plates of the two metals, kept in metallic communication and allowed to approach one another, will experience an elevation of temperature; but, if the contact-difference increases with temperature, the effect of mutual approach will be a lowering of temperature. On the former supposition, the diminution of intrinsic energy in quantities of zinc and copper, consequent on mutual approach with temperature kept constant, will be greater, and, on the latter supposition, less than I have estimated above. Till the requisite experiments are made, farther speculation on this subject is profitless; but, whatever be the result, it cannot invalidate the conclusion that a stratum of 1-200,000,000th of a centimetre thick cannot contain in its thickness many, if so much as one, molecular constituent of the mass.

Besides the two reasons for limiting the smallness of atoms or molecules which I have now stated, two others are afforded by the theory of capillary attraction and Clausius's and Maxwell's magnificent working out of the kinetic theory of gases.

In my letters to you already referred to, I showed that the dynamic value of the heat required to prevent a bubble from cooling when stretched is rather more than half the work spent in stretching it. Hence, if we calculate the work required to stretch it to any stated extent, and multiply the result by  $\frac{3}{2}$ , we have an estimate, near enough for my present purpose, of the augmentation of energy

\* Will you try this experiment? You would easily make a good thing of it.

† *Proceedings of the Royal Society* for April, 1858.



experienced by a liquid film when stretched and kept at a constant temperature. Taking 0.08 of a gramme weight per centimetre of breadth as the capillary-tension of a surface of water, and, therefore, 0.16 as that of a water-bubble, I calculate (as you may verify easily) that a quantity of water, extended to a thinness of 1-200,000,000th of a centimetre, would, if its tension remained constant, have more energy than the same mass of water in ordinary condition by about 1100 times as much as suffices to warm it by 1° C. This is more than enough (as Maxwell suggested to me) to drive the liquid into vapour. Hence, if a film of 1-200,000,000th of a centimetre thick can exist as liquid at all, it is *perfectly certain* that there cannot be many molecules in its thickness.

The argument from the kinetic theory of gases leads me to quite a similar conclusion.

## NOTICES OF BOOKS.

*First Report of the Commissioners Appointed in 1868 to Inquire into the Best Means of Preventing the Pollution of Rivers. (Mersey and Ribble Basins.)* Vol. i. 1870.\*

WE have here a folio volume of some 140 pages, containing, as may be imagined, an enormous amount of condensed useful and highly interesting information. The work is divided into two main parts—viz., River Pollution (sub-divided into two sections—A, Descriptive; B, Remedies) and Water Supply. The River Pollutions are classed under two heads—viz., Sewage and Manufacturing Refuse. The chemical difference between polluted and unpolluted water is clearly defined as follows:—

“Absolutely pure water is not to be found in nature. Even at the moment of its condensation in the atmosphere from invisible vapour to visible cloud, water absorbs gases, and becomes also contaminated with a fine dust which is everywhere floating in the air. When it falls to the earth as rain, it percolates through strata, or flows over surfaces more or less soluble, and dissolves, according to circumstances, quantities of solid matter varying generally from about 3 lbs. to 50 lbs. in 100,000 lbs. of water. In addition to these inevitable impurities, natural and unpolluted water is not unfrequently turbid from insoluble substances suspended therein in a finely-divided condition.

“The following are the chief characteristics of unpolluted water:—It is tasteless and inodorous, possesses a neutral or faintly alkaline reaction, rarely contains in 100,000 lbs. more than  $\frac{1}{2}$  lb. of carbon and 1-10th lb. of nitrogen in the form of organic matter, and is incapable of putrefaction even when kept for some time in close vessels at a summer temperature.

“Of the different kinds of pollution affecting rivers, animal organic matter, as it occurs in sewage, is that which renders water not only most offensive to the senses, but most likely to injure health, both by its gaseous emanations and by its deleterious effects when used as a beverage. Rivers so polluted frequently contain from 1 lb. to more than 2 lbs. of organic carbon, and from  $\frac{1}{2}$  lb. to  $\frac{1}{4}$  lb. of organic nitrogen, in 100,000 lbs. Pollution by vegetable organic matter, such as that caused by dye and print-works, stands next, as regards offensiveness; water so polluted being excessively unpleasant, not only to the sight, but also, in warm weather, to the sense of smell. It often contains, in 100,000 lbs., twice as much organic carbon as is present in water polluted by sewage, but, owing to the comparatively small proportion of nitrogen in vegetable substances, it rarely contains more than one-third of a pound of organic nitrogen. Chemical works contribute chiefly mineral impurities, which often communicate to water extreme hardness and other disagreeable and even poisonous properties.”

The following is a brief summary of the chemical researches instituted:—

\*The Commissioners are Dr. Frankland, F.R.S., Sir William Denison, F.R.S., and Mr. J. C. Morton.

“(a.) The total amount of solid matters present in solution:—The most important constituents of these solid matters are—

“1. Organic carbon.

“2. Organic nitrogen.

“3. Ammonia in the form, chiefly, of carbonate of ammonia.

“4. Nitrogen in the form of salts of nitric acid and nitrous acid.

“5. Total combined nitrogen.—This determination sums up the whole of the analytical evidence against the water, as regards both past and present organic contamination.

“6. Chlorine. The proportion of chlorine in water may often be used as an indication of the extent to which a stream has been contaminated with *sewage*, as distinguished from *solid* animal matters. The chlorine in river water is almost always combined with sodium as common salt, which is a large and essential constituent of urine, and consequently of sewage, whilst it is present in only comparatively minute quantity in solid manure. It is scarcely necessary to say, however, that the determination becomes valueless for this purpose in the neighbourhood of the sea and of natural deposits of salt—such as that existing in the valley of the Weaver, for instance. The normal proportion of chlorine, as common salt, existing in this country in waters which have never been polluted by excrementitious matters, is about 1 part in 100,000 of water. Most of this is probably carried from the ocean to the land through the air as sea-spray or fine particles of salt; for we find that the unpolluted waters of an inland country like Switzerland contain only about 0.2 part of chlorine in 100,000 parts.

“7. Hardening constituents.

“(b.) The total amount of solid matters in suspension:—In this it is very important to distinguish between organic and mineral matters. We have therefore determined—

“1. The organic matters in suspension.

“2. The mineral matters in suspension.”

The alleged self-purification of polluted rivers, a subject of paramount importance, is treated of in the following terms:—

“At the time the winter samples were taken, the rivers were not in a state of putrefaction; any purification which they underwent during their progress towards the sea was, therefore, produced at this time either by the oxidation of the polluting organic matter contained in the solution, or by the subsidence of the suspended matters. It has often been stated, but, so far as we know, without any proof, that the organic matter contained in sewage and other similar polluting materials is rapidly oxidised during the flow of a river into which such materials are discharged. Thus, it has been asserted (“Report of Royal Commission on Water Supply,” p. 79), that if sewage be mixed with twenty times its volume of river water, the organic matter which it contains will be oxidised and completely disappear whilst the river is flowing a ‘dozen miles or so.’ We thought it very undesirable that a subject of such vital importance to our inquiry should any longer rest upon mere opinion, and we therefore determined to submit it to careful experimental investigation. During our winter visit to the basins of the Mersey and Ribble, a very favourable opportunity presented itself for the solution of this important problem. The river Mersey, after receiving the drainage of many towns and manufactories above the Stretford Road Bridge, flows thence 13 miles, to its junction with the Irwell, without encountering any other material source of impurity, although its volume is somewhat augmented by unpolluted affluents. The river Irwell, after passing Manchester, falls over a weir at Throstlenest, and runs 11 miles, to its junction with the Mersey, without further material pollution, and with but very unimportant unpolluted affluents. Lastly, the river Darwen, which is greatly polluted by the sewage of Over Darwen, Lower Darwen, and Blackburn, joins the Blakewater just below the latter town, and then flows 13 miles, to near its junction with the Ribble at Walton-



le-Dale, without any further pollution, although its volume becomes more than doubled in this part of its course by the accession of the river Roddlesworth, the Alum-House brook, and numerous small affluents, all of which are unpolluted.

"We took samples of water at the top and bottom of the courses of these rivers at the places just indicated, viz.—1. The Mersey at Stretford Road Bridge, and again just before its junction with the Irwell. 2. The Irwell, as it fell over the weir at Throstlenest, and again just before its junction with the Mersey; similar samples of this river being also taken in May and June following. 3. The Darwen, one-third of a mile below its junction with the Blakewater, and again 50 yards above the bridge at Walton-le-Dale."

The main result of these experiments is summarised in the following words:—

"It is thus evident that, so far from sewage mixed with 20 times its volume of water being oxidised during a flow of 10 or 12 miles, scarcely two-thirds of it would be so destroyed in a flow of 168 miles, at the rate of 1 mile per hour, or after the lapse of a week. But even this result is arrived at by a series of assumptions which are all greatly in favour of the efficiency of the oxidising process. Thus, for instance, it is assumed that the 62.3 per cent of sewage is thoroughly oxidised and converted into inoffensive inorganic matter; but the experiments showed that, in fact, no sewage whatever was so converted or destroyed, even after the lapse of a week, since the amount of carbonic acid dissolved in the water remained constant during the whole period of the experiment; whilst, if the sewage had been converted into inorganic compounds, the carbonic acid, as one of these compounds, must have increased in quantity.

"Thus, whether we examine the organic pollution of a river at different points of its flow, or the rate of disappearance of the organic matter of sewage when the latter is mixed with fresh water and violently agitated in contact with air, or, finally, the rate at which dissolved oxygen disappears in water polluted with 5 per cent of sewage, we are led, in each case, to the inevitable conclusion that the oxidation of the organic matter in sewage proceeds with extreme slowness, even when the sewage is mixed with a large volume of unpolluted water, and that it is impossible to say how far such water must flow before the sewage matter becomes thoroughly oxidised. It will be safe to infer, however, from the above results, that there is no river in the United Kingdom long enough to effect the destruction of sewage by oxidation."

This is confirmed by the evidence given by Sir B. Brodie, before the former Rivers Pollution Commission, in the following words:—

"I should say that it is simply impossible that the oxidising power acting on sewage running in mixture with water over a distance of any length is sufficient to remove its noxious quality. Taking the case of Oxford: if the sewage of Oxford was, in its entirety, discharged into the river Thames, I should say that we could certainly not trust to the oxidising power to take away the noxious quality of the water before it reaches, say, Teddington. I presume that the sewage could only come in contact with oxygen from the oxygen contained in the water, and also from the oxygen on the surface of the water; and we are aware that ordinary oxygen does not exercise any rapidly-oxidising power on organic matter. I believe that an infinitesimally-small quantity of decayed matter is able to produce an injurious effect upon health; therefore, if a large proportion of organic matter was removed by the process of oxidation, the quantity left might be quite sufficient to be injurious to health. With regard to the oxidation, we know that, to destroy organic matter, the most powerful oxidising agents are required; we must boil it with nitric acid and chloric acid and the most perfect chemical agents. To think to get rid of organic matter by exposure to the air for a short time is absurd."

(To be continued.)

## CORRESPONDENCE.

### ACTION OF IODINE ON HYPOSULPHITE.

*To the Editor of the Chemical News.*

SIR,—In reply to the letter of Mr. E. Sherer in the CHEMICAL NEWS (vol. xxi., p. 141) I have to say that my experiments on the action of iodine and hyposulphite solutions were performed immediately after his paper, "On the Estimation of Manganese Ores," was read before the Newcastle Chemical Society (Nov. 25th, 1869), and were sent to that Society before the appearance of his further note on the subject in the CHEMICAL NEWS (vol. xxi., p. 48). His statement, that the increased amount of iodine formed on allowing the liquid obtained in Bunsen's process to stand some hours "was caused by the conversion of iodine into hydriodic acid" (*sic*), did not appear in the original paper read in Newcastle.—I am, &c.,

C. R. A. WRIGHT.

Washington Chemical Works, Durham,  
April 2, 1870.

### MANUFACTURE OF SULPHURIC ACID.

*To the Editor of the Chemical News.*

SIR,—I was just going to answer the objections which Mr. Gibbins made, in the CHEMICAL NEWS (vol. xxi., p. 132), to my proposed improvement in the manufacture of sulphuric acid, when I saw the letter of Mr. P. Spence, stating that he has already tried, in his large chemical works, some experiments on the subject. Mr. P. Spence answering, in every respect to my full satisfaction, the objections of Mr. Gibbins, I have only few words to add.

For the last three years, a great number of vitriol chambers here work at a high specific gravity; but they are arranged different from those of Mr. Spence. The sulphurous acid comes in contact with the nitric acid in a little chamber of a capacity of scarcely 100 cubic metres (called, in France, *tambour*); it is in this chamber that the action of the two acids takes place. No aqueous vapour, or very little, is introduced in this chamber, and the vitriol manufactured is kept at a specific gravity of 1.715. When this chamber is first set at work, there is no doubt that a layer of sulphate of lead is formed; but, as no aqueous vapour is introduced, it remains on the lead, and protects it against a further action. I have cut out a piece of lead of 10 c.c. after a trial of three years, and I found that it weighed as much as an equal piece of lead of a chamber which, during the same lapse of time, worked otherwise than by my system.

Mr. Gibbins is quite right in saying that the vitriol manufactured under these circumstances is so charged with nitrous acid that, on concentration, a great loss of nitric acid is caused; but, as Mr. P. Spence explains very well, this acid is not employed directly, but is run into a series of different chambers, where it loses so completely all nitric acid, by the action of sulphurous acid, that the vitriol which is run off no longer gives a colouration on addition of sulphate of iron.—I am, &c.,

P. W. HOFMANN.

Société Anonyme des Anciennes Salines  
Domaniales de l'Est.  
Etablissements de Dieuze (Meurthe),  
April 4th, 1870.

### MAGNETIC PHENOMENA.

*To the Editor of the Chemical News.*

SIR,—Having recently met with some curious results in the shape of magnetic phenomena, I take the liberty of transmitting you an account of them. Having magnetised an ordinary needle by means of a small horseshoe (1 inch



across at the poles), I floated it on some water, when it arranged itself in the magnetic meridian and exhibited the usual attraction and repulsion to a small bar magnet. The horseshoe was now rubbed to and fro upon the northern half of this bar (which was four inches long, and about the thickness of a lucifer) for several times from position *a*, in which the horseshoe's south occupies the bar's centre, and its north is intermediate between that of the bar and its centre to position *b*, in which the horseshoe's and bar's north are both in contact, as shown in the annexed diagram,



Upon trial it was found that both poles of the bar were now south, attracting the north of the floating needle and repelling its south. A repetition of the experiment on the southern half of a similar bar resulted in two north poles. Another magnetic bar being then obtained, the horseshoe was left in position (*b*) for ten seconds,



when the extremity, which had been thus exposed, was found to repulse the needle's south when presented to it within the space of one-eighth of an inch, and to attract its north when placed in like proximity to it, but, beyond this distance, the reverse phenomena was exhibited the same as before exposure. After exposing in the same way for another ten seconds, the equilibrated points were found to have become situated farther from the needle's extremities, and other repetitions gradually removed them to the distance of half an inch, the south of the floater then always retiring to that distance from the bar's affected extremity or approaching thereto, according as the bar was presented within or beyond it; whilst the floater's north acted in manner precisely reverse. The way in which the south followed the bar when moved slowly excited the impression of its being in some manner moored to it.

Still further exposure to the horseshoe did not produce any further change until it was made at a position nearer the bar's centre: thus—



upon which the equilibrated points separated to greater distances, and, at length, had retired further than the bar's magnetism was perceptible, so that its north pole now appeared an ordinary south as in the first of our experiments. The result of that experiment being thus obtained in successive steps.

Further experiment yielded analogous results with the bar's other pole, and it was found that contact with the horseshoe in a reversed position always neutralised the effect of contact in the other.

The following experiment was then made with the floating needle:—

Its north was exposed to the horseshoe's north for a short interval as annexed, but not permitted to approach it nearer than the sixteenth of an inch.



Upon refloating, it was found to have lost some of its directive power (shown by its moving more slowly to the magnetic meridian), and by cautious repetition of similar exposure this power was at length totally destroyed, and a floating needle obtained which remained quiescent in whatever position was given to it, and exhibiting two south poles.

To assist in producing these results it may be observed

that should the horseshoe's north be applied too long to the needle's extremity, this extremity will become more powerfully south than the other, in which case the needle will not fail to arrange itself as usual. This, however, may be counteracted by a momentary exposure to the horseshoe's south, so that the experimenter will be enabled to bring about the conditions sought in all cases very readily by such alternation.

In conclusion, it may be remarked, that needles with similar poles at both extremities always exhibit the opposite magnetism somewhere within their length, and that the double poled results appear to be permanent.—I am, &c.,

EDWARD PORTER, jun.

478, Crown Street, Sydney.

PS. I enclose a needle, which was prepared in January, 1869, exhibiting two south poles, as may be proved by floating it and applying a magnetised bar near either extremity, when either will be found to recede from a south and approach a north pole. Care must be taken to prevent the needle's contact with any magnet lest its properties be altered.

## MISCELLANEOUS.

Female Students of Chemistry.—Yesterday, at the Chemistry Class in the University, the results of the examinations held in the course of the session were announced by Professor Crum Brown, who stated that 13 of the students had attained first-class honours. Their numbers stood as follows:—87, 86, 85, 84, 82, 81, 80, 80, 78, 76, 75, 75, 75. The third name on this list is that of Miss Mary Edith Pechey (85); the tenth that of Miss Sophia Jex Blake (76)—two of the six lady students who, in accordance with the decision of the University authorities at the beginning of the session, had been admitted to study in the medical classes. To the four students whose names stand highest in the Chemistry Class for the session the Hope scholarships fall to be awarded, two of which entitle the holder to attend at the laboratory for the winter and summer sessions, and two for six months only. Dr. Crum Brown, however, announced yesterday that the scholarships would be given, not to the four students highest on the list, but to Messrs. (1) Wilson (2) Alston, (4) Young, and (5) M'Queen—Miss Pechey's name, which stood third, being thus dropped out, though it was at the same time announced that Miss Pechey was entitled to, and would receive, one of five medals awarded to the five highest students of the session. This decision, which is not, we understand, likely to pass unchallenged, seems the more ungracious when the origin of the scholarships—of what seems her clear right to one of which Miss Pechey has thus been arbitrarily deprived—is considered. They arose out of the success of a course of lectures given a number of years ago by Dr. Hope, then Professor of Chemistry, to a ladies' class held in the University. Dr. Hope was so much gratified by the popularity of these lectures that, with their proceeds (amounting to about £1000), he founded the scholarships in question. It is rather remarkable that, on the first occasion on which ladies have had the chance of competing for these scholarships, one of them should have triumphantly entitled herself, by her position in the class, to this honour and reward—still more remarkable, surely, that she should not receive it. The facts as to Miss Pechey's eminence are even stronger than they appear as stated above; for we understand that both the gentlemen whose names precede hers had attended a previous course of chemistry. So that Miss Pechey's position is absolutely the highest of all the students who may be classed as students of the year, the whole number of the class being about 236, inclusive of the six ladies.—*The Scotsman*, March 29th.



## CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus des Séances de l'Académie des Sciences, March 28, 1870.

This number contains the following papers relating to chemistry and physical sciences:—

Application of an Electric Current in Calorimetry.—J. Jamin. this paper is divided into the following sections:—Application in the case of solids and liquids; gases and vapours; latent heat; the two specific heats.

Specific Heat of Water between 0° and 100°.—J. Jamin and A. Amaury.—An algebraico-physical paper, containing a very large number of tabulated results, in figures. There is annexed to this paper another, by V. Regnault, containing a series of observations and remarks on the contents of the essay of the authors.

On Trichlorhydrine and Substances Isomeric therewith.—J. Berthelot.—The chief leading points of this lengthy paper are that hitherto no trichlorhydrine has been prepared, except by the aid of substances derived from glycerine. There exist, moreover, at the very least, five bodies isomeric with trichlorhydrine, viz.:—(1) The chlorinated derivatives from the hydride of propylene,  $C_3H_8$ , including, in all probability, those of the normal propyl-chlorhydrine ether; (2) the derivatives from the chlorhydrate of propylene,  $C_3H_6.HCl$ , or the isopropyl-chlorhydrine ether; (3) the derivatives from the normal chloride of propylene,  $C_3H_7.Cl$ , corresponding to the chloride of ethylene and diatomic alcohol; (4) the derivatives from dichlorhydrine acetone; (5) the derivatives from trichlorhydrine,  $C_3H_5.Cl_3$ , corresponding to glycerine—that is to say, a normal triatomic alcohol.

Supersaturation of Chloride of Calcium.—E. Lefebvre.—This paper is an excellent contribution to the study of the phenomena presented by some saline solutions under various circumstances. The author first alludes to the well-known phenomenon presented by solutions of sulphate of soda, under certain conditions, which crystallise instantaneously. Solutions of chloride of calcium, and of the chlorides of strontium and barium, exhibit, if properly concentrated, the same sudden crystallisation; and the contents of this paper record the results of the author's extensive researches on this subject.

Chemical Research on Eucalyptol.—S. Cloëz.—The tree known by the name of *Eucalyptus globulus*, a native of Tasmania (where this species was discovered, in 1792, by M. Labillardière) has been successfully acclimatised in the southern parts of France and other parts of Southern Europe. The author has discovered, in the leaves of that tree, a substance which he has named eucalyptol, a liquid specifically lighter than water, viz.—0.905 at 8°. Eucalyptol is difficultly soluble in water, but easily soluble in alcohol; this solution, when very dilute, has an odour analogous to that of roses. The formula of this substance is  $C_{21}H_{20}O_2$ ; its vapour density, 6.22. Treated with anhydrous phosphoric acid, eucalyptol yields eucalypten,  $C_{21}H_{18}$ . The quantity of eucalyptol contained in the leaves of this tree, which, by-the-bye, is, like the other eucalyptus species, remarkable on account of growing to heights of 80 and 100 metres, varies from 2.75 to 6 per cent.

Zeitschrift für Analytische Chemie, Nos. 3 and 4, 1869 (continued).

Contribution to the Knowledge of the so-called Nitrate of Iron of Commerce.—E. Lenssen.—Under the above name, there is met with in commerce an oily fluid of a blackish brown colour, and generally as heavy as 50° Baumé (1.525 sp. gr.); it tastes rather astringent, while it gives off a smell of nitrous acid; it is used very largely in dyeing and printing. The author has analysed several different samples of this material and gives the following three analyses as instances of what is sold (on the Continent) for nitrate of iron. Sample marked N contained, in 100 parts—Peroxide of iron, 18.8; protoxide of iron, 0.4; sulphuric acid, 23.3; hydrochloric acid, 0.9; water, 56.6 = when formulated and in percentages— $Fe_2Cl_3$ , 1.3;  $FeO.SO_3$ , 0.8;  $Fe_2O_3.3SO_3$ , 22.9;  $Fe_2O_3.2SO_3$ , 18.2; water, 56.8. Sample marked L contained, in 100 parts—Peroxide of iron, 20.10; sulphuric acid, 19.74; hydrochloric acid, 3.96; nitric acid, 2.18; water, 54.02 = formulated and per centically— $Fe_2Cl_3$ , 5.86;  $Fe_2O_3.3NO_3$ , 3.25;  $Fe_2O_3.3SO_3$ , 17.95;  $Fe_2O_3.2SO_3$ , 17.94;  $HO$ , 55.0. Sample marked T—Peroxide of iron, 18.04; sulphuric acid, 21.69; hydrochloric acid, 1.68; nitric acid, 1.12; water, 54.47 =  $Fe_2Cl_3$ , 2.50;  $Fe_2O_3.3NO_3$ , 1.67;  $Fe_2O_3.3SO_3$ , 27.15;  $Fe_2O_3.2SO_3$ , 10.80; water, 57.88. The sp. gr. of all these samples was exactly 1.525. This lengthy paper contains, further, very valuable information on the use, the best mode of manufacture, and the best methods of analysis and practical assay of this material, which is especially used to increase the weight of silk when that material is to be dyed black or blue of certain shades.

Methods of Research in Water Statistics.—Dr. H. Trommsdorff.—Under this title, the author gives a treatise on water analysis, divided into the following sections:—Hydrotimetry, description of the apparatus for measuring and preparation of the titrated soap solution; estimation of total hardness; estimation of the carbonate and sulphate of lime, of the magnesia salts, and of the free carbonic acid; estimation of the permanent hardness; estimation of the magnesia salts; description of the hydrometrical method of the estimation of the total sulphates; estimation of chlorine; estimation of organic substances; general preliminaries; preparation of volumetrical solutions; description of the application of these solutions; estimation of ammonia; colorimetrical estimation of ammonia; preparation of Nessler's test, and of a standard solution of chloride of ammonium; estimation of nitrous acid; estimation of nitric acid.

Precipitation and Estimation of Manganese by Hydrosulphuret of Ammonium.—Dr. A. Classen.—This paper is a lengthy series of tabulated results of volumetrical experiments made under the following headings:—Behaviour of mono-hydrosulphuret of ammonium with a solution of manganese in the presence of chloride of ammonium; behaviour of poly-hydrosulphuret of ammonium with a precisely similar solution; behaviour of mono-hydrosulphuret of ammonium containing free ammonia with a precisely similar solution of manganese; behaviour of poly-hydrosulphuret of ammonium containing free ammonia with a solution of manganese containing chloride of ammonium; behaviour of mono-hydrosulphuret of ammonium with a solution of manganese containing variable quantities of chloride of ammonium and free ammonia; behaviour of poly-hydrosulphuret of ammonium with manganese solutions as foregoing.

Utilisation of the Liquids containing Molybdic Acid from the Residues of Phosphoric Acid Estimation.—Dr. F. Muck.—The acid liquors, the filtrates from the yellow precipitate, are mixed with the ammoniacal wash-waters from the ammonio-phosphate of magnesia precipitates, and, in addition, there is added phosphate of soda solution, in the proportion of 1 part of phosphoric acid to 30 of molybdic acid; after which, the fluid is left at rest for twenty-four hours in a warm place. The precipitate is collected on a filter and washed, until the filtrate begins to run slightly turbid; the precipitate is next dried in a water-bath, and next dissolved in ammonia (360 parts to 100 of precipitate), and this solution is poured into nitric acid (1350 parts) into which, previously, from 2 to 3 parts of pure magnesia have been dissolved. The ensuing precipitate of ammoniacal phosphate of magnesia is next removed; and, after having been standing for some time, in order to give time for a small quantity of phosphate of molybdenum to settle down, the solution is fit for use again as molybdate of ammonia.

Concentrated Sulphuric Acid, a Test for Molybdic Acid.—Dr. Schönn.—When molybdic acid, or the ammonia, soda, lead, or baryta salts of that acid are heated in a porcelain capsule, with just sufficient sulphuric acid to moisten the material, of which only a few small bits (less than two milligrams) suffice for the experiment, there will be observed the appearance of a blue, ultramarine-like colouration, which disappears again when the sulphuric acid is evaporated. When quantities of 10 milligrams and upwards are acted upon, the blue colour is evidenced, even at the ordinary temperature, but it is best to add a few drops of alcohol. A solution of molybdic acid has to be first evaporated to dryness, and the native sulphide of molybdenum must be first converted into molybdic acid, before this most sensitive test can be applied; neither titanate, tungstic, or vanadic acid exhibit this phenomenon when similarly treated with sulphuric acid.

Fusion of Substances with Sodium or Potassium.—Dr. Schönn.—A lengthy paper on some methods of fusion and ignition whereby sodium (being the cheapest) is applied to disintegrate and decompose, at a high temperature, various substances. We regret that the paper is not suited for useful abstraction.

Estimation of Uranium.—Dr. C. Winkler.—The author reviews and criticises Patera's labours on this subject, and chiefly points out some mistakes made in his calculations, as published in a former volume of this periodical.

Direct Estimation of Valerianic Acid in Valerianates.—A. Zavatti and F. Sestini.—Since the method of quantitative estimation here proposed and described is acknowledged and admitted by the authors to be invariably attended with a loss of at least 6 per cent of the substance to be estimated, we need not enter into details on this subject.

Phenylate of Potassa as a Test for the Presence of Water in Ether.—J. Romei.—Perfectly dry phenylate of potassa is quite insoluble in anhydrous ether, but partly dissolves in that liquid when containing water, and then imparts to it a reddish brown colour. The author found that, even when the ether contains only 2.5 parts of water in 1000 of ether, the test is perfectly perceptible.

Reduction of Small Weights.—Dr. K. L. Bauer.—An algebraical essay.

Composition of Atmospheric Air at Various Heights.—Dr. K. L. Bauer.—This paper contains a series of cypher figures derived from a formula (algebraic) as given by V. Regnault.

Behaviour of Sodium and Magnesium with Substances, and especially Liquids, which contain Sulphur.—Dr. Schönn.—After briefly referring to a former paper on this subject, the author now states that, instead of sodium, pulverised magnesium can be used for the detection of sulphur, in the following manner:—The substances to be tested (for instance, the sulphates of lime or baryta) are thoroughly mixed, previously reduced to powder, and next heated to redness with the metal in a test-tube made of thin hard glass. After the reaction is over, the contents of the tube are, when quite cold, treated with distilled water and tested with nitro-prusside of sodium; organic substances—e.g., previously-carbonised albumen—may be tested in the



same manner for sulphur. As regards liquids containing sulphur, the author states that a drop of sulphuric acid, when brought into contact with sodium, yields, among the products of the reaction, sulphuret of sodium; with magnesium, this reaction does not take place unless heat be applied. Sulphide of carbon and essential oil of mustard may be readily proved to contain sulphur by application of the same test.

**Very Simply-Constructed Small Sulphuretted Hydrogen Gas Apparatus.**—G. Hinrichs.—Illustrated with a woodcut essentially necessary for the proper understanding of the description.

**Quantitative Estimation of Carbon in Pig-Iron.**—Dr. R. Fresenius.—The weighed quantity of iron to be tested for carbon is placed on a small porcelain boat and introduced into a hard glass combustion-tube, placed in a combustion-furnace, and, when red-hot, a current of dry chlorine gas (dried by making it pass over pieces of pumice-stone moistened with strong sulphuric acid) is passed over; the current of gas and application of a low red heat is continued until all the iron is volatilised as chloride. The carbon left in the small boat is, after the apparatus has cooled, placed in a porcelain tube and burned. After being heated to redness in a current of oxygen, the products of the composition are taken up by Liebig's potash-bulbs. Great care is required that the chlorine be thoroughly dry, since, otherwise, hydrocarbons may be formed and some carbon lost.

**Behaviour of the Vapours of Nitrous and Hyponitric Acid when Daylight passes through them.**—Dr. E. Luck.—This paper contains a series of observations on the spectra exhibited by these substances.

**Absorption-Spectrum of Perchloride of Manganese ( $Mn_2Cl_7$ ).** Dr. E. Luck.

**Behaviour of Hypochloric Acid with Brucine and its Salts, and on the Value of the Reaction of Brucine for Detecting Small Quantities of Nitric Acid.**—Dr. E. Luck.—The main point of interest of this paper is the fact that, when brucine comes into contact with hypochloric acid and free sulphuric acid, there appears a highly-red colouration, which disappears on the addition of tin-salt. The use of brucine for the detection of nitric acid is, according to the author's researches, not very reliable, and less distinct than the reaction of phenol-sulphuric acid with nitric acid.

**Solubility of Cream of Tartar (Bitartrate of Potassa) in Aqueous and Alcoholic Fluids; Testing of the Berthelot Fleurien Method for the Quantitative Estimation of that Salt, and of Tartaric Acid, in Wine.**—E. Kissel.—This lengthy paper, and the following—

**Estimation of Acetic Acid in Wine.**—E. Kissel.—Are too extensive for useful abstraction, and, moreover, chiefly interesting in vine-growing and wine-producing countries.

**Composition of the Carbonates of Manganese.**—E. Prior.—The author describes, at very great length, a series of experiments in order to elucidate the real composition of carbonate of manganese, prepared in different ways and with pure materials, and with precautions as regards its alteration by oxidation. The precipitate produced in a solution of pure and neutral sulphate of manganese by the addition of carbonate of ammonia is, after very careful drying *in vacuo*, composed, in 100 parts, of— $MnO$ , 57.25;  $CO_2$ , 35.48;  $HO$ , 7.27. Formula,  $2(MnO,CO_2)+HO$ . The precipitate produced by carbonate of soda in solutions of salts of protoxide of manganese is composed, in 100 parts, of— $MnO$ , 61.73;  $CO_2$ , 38.27. The precipitate, however, of carbonate of manganese, as usually obtained by precipitating a proto-salt of that metal with carbonate of soda, was found to consist, after drying at  $60^\circ$ , in 100 parts, of— $MnO$ , 62.11;  $CO_2$ , 37.89.

**Action of Boiling Saline and other Solutions upon Vessels of Glass and Porcelain.**—W. Casselman.—This very lengthy paper contains the results of an extensive series of experiments, from which the following general results are derived:—Water and acids hardly, if at all, act upon good porcelain vessels; the fixed alkalies attack porcelain, but less so than they do glass, which is far more readily and generally acted upon by the substances alluded to, as well as by saline solutions.

*Journal de Pharmacie et de Chimie*, March, 1870.

This number contains the following original papers and memoirs:—

**Two Products of the Boletus Laricis (a kind of Mushroom).**—G. Fleury.—The author has separated from this, previously dried and pulverised, cryptogamic plant, a resinous substance, insoluble in water; soluble in ether, absolute alcohol, chloroform, and acetic acid; insoluble in benzol and sulphide of carbon; and fusing at  $89.7^\circ$ . Caustic potassa solution and ammonia take up this body, yielding solutions which froth very strongly. This resin consists, in 100 parts, of—Carbon, 71.6; hydrogen, 9.6; oxygen, 18.8; its barium compound is  $C_{51}H_{82}BaO_{11}$ . Agaricic acid, a white crystalline body, fusing at  $145.7^\circ$ , soluble in alcohol, but hardly soluble in water or ether. Percentage composition—Carbon, 64.0; hydrogen, 9.3; oxygen, 26.7.

**Preparation and Properties of Hydrate of Chloral.**—J. Personne, and—

**Report on some Facts relating to the History of the Hydrate of Chloral.**—MM. Roucher, Lebaigue, and Jungfleisch.—Are, although valuable, strictly pharmaceutical papers.

**Search for Cyanhydric Acid in Tobacco Smoke.**—Drs. Poggiale and Marty.—Since Dr. Vogel, in Germany, had stated that he had very readily detected cyanhydric acid in tobacco smoke, by means of Schoenbein's test-paper for that acid, the authors have very carefully conducted a series of experiments, by means of aspirators, with tobacco

(200 grms. at a time) placed in the bowl of a large pipe, and have tested the smoke, as well as the tarry and oily products of the combustion of tobacco, with the following results:—Tobacco smoke does not contain any hydrocyanic acid; neither is any found in the other (condensed) products of the combustion of tobacco. The authors also state that Schoenbein's prepared paper for the detection of cyanhydric acid is not reliable for that purpose; while they have applied proper tests, and compared these with fluids to which either cyanhydric acid or cyanides had been purposely added.

*Les Mondes*, March 31, 1870.

**Decrease of the Temperature of the Air in relation to the Elevation Above Sea Level.**—Dr. Hann.—This author has tried to solve, experimentally, or, rather, by observation, the problem of the decrease alluded to by comparing the average of temperature, as observed at certain groups of stations situated under the same mean latitude and longitude, and by taking into account local influences. Seven of these groups are situated in the western portion of the Alps, at from 230 to 3330 metres above sea level; four in the northern part of Switzerland, at from 500 to 1780 metres above sea level; three in the Rauhe Alps (Wurtemberg), at from 310 to 810 metres above sea level; four in the Erzgebirge (Central Germany), at from 180 to 850 metres above sea level; and four in the Harz (province of Hanover and Brunswick), at from 70 to 1140 metres above sea level. The results obtained have proved that, in the instances mentioned, the decrease of the temperature of the atmosphere near to the ground is really proportionate to the height of the locality above sea level. When the results of all the observations are duly considered, there is discovered to exist a very strongly-marked annual periodicity, and a very uniform decrease of temperature from below to above, the average relation of the temperature reigning in December being, to that of June, as 1 to 2.

*Bayerisches Industrie und Gewerbe Blatt*, January and February, 1870.

These numbers contain, as usual, the full texts of a great number of official communications, chiefly of local importance, and, in addition thereto, the following papers relating to chemistry and collateral sciences:—

**Supply and Quality of the Water Used for Domestic Purposes to the City of Munich.**—Dr. A. Wagner.—It appears, from this paper, that the capital of Bavaria is exceedingly well off, both as regards the sources of supply, the quantity and quality of the water, which is very pure, containing, as it does, only from 0.16 to 0.60 grms. of solid matter (organic inclusive) to the litre of fluid.

**Substitute for Copper for the Daniell Electric Battery.**—Dr. C. Stölzel.—The author says—Take a piece of well-polished tin-plate (sheet tin, not tinned iron), immerse it in a very dilute solution of a copper salt, and put it in connection with a weak galvanic current. After the lapse of from fifteen to eighteen hours, a layer of strongly-adhering metallic copper will have become firmly deposited upon the tin-plate; and the latter, after having been bent into the required shape, is an excellent, cheap, and durable substitute for the copper cylinder in Daniell's battery.

**Collieries near Miesbach, Upper Bavaria.**—F. Hailer.—An excellent monograph, from which it appears that, as far back as the year 1447, pit-coal was known, and in use (limited, however), in that district.

**Albolith.**—W. Riemann.—Under this name, the author prepares a cement chiefly consisting of magnesia. For this purpose, the magnesite of Frankenstein (Silesia) is ignited in retorts similar to those used for gas manufacture; and, after the mineral (a native carbonate of magnesia) has been ignited, it is mixed with silica and some other substances not specified. This mixture has the property of yielding, with moderately-concentrated solutions of chlorides (for instance, chloride of magnesium), a most extremely plastic, but, on drying, a very hard material, excellently adapted for use as cement for stucco and ornamental work, and instead of gypsum.

These numbers also contain the programme of a General Industrial Exhibition intended to be opened at Cassel (Prussia) in June next. The object of this Exhibition is very similar to that held at Amsterdam last year.

*Journal für Gasbeleuchtung*, February, 1870.

This number contains—

**Regulations for the Inspection and Testing of Gas Meters for the Grand Dukedom of Oldenburg.**

**Collection of Facts relating to the Supply of Potable Water for Altenburg, Berlin, Zürich, and a large number of Cities and Towns of Germany, Austria, Hungary, and Northern Italy.**

*Polytechnisches Journal von Dingler*, first number for February, 1870.

The number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

**Thermometer and Pyrometer Provided with Automatical Electric Signalling Apparatus.**—O. Zabel.—This paper is illus-



trated with a series of engravings, absolutely required for the proper understanding of the useful contrivances herein described.

**Combined Areometer.**—Dr. H. Bardeleben.—This lengthy memoir, also illustrated with an engraving, describes an instrument—an ingenious combination of the scale and the weight areometer—whereby the determination of the specific gravities of solid bodies is rendered easily performed, while the instrument serves, at the same time, the purposes of the areometers in ordinary use.

**Application of Gas to Blast Furnaces.**—F. Lürmann.

**On Rapakiwi as a Suitable Material of the Manufacture of Bottle-Glass.**—H. G. Benrath.—The material known in Finland (a portion of the Russian Empire) as rapakiwi, and wrought in the quarries of Pyterlak, consists, in 100 parts, of—Silica, 74.24; alumina, 12.13; peroxide of iron, 2.88; lime, 0.90; magnesia, 0.19; potassa, 6.68; soda, 2.50; water, 0.04. The author describes, further in his paper, a series of experiments made with the view to ascertain the most suitable materials, and the quantities thereof, to be mixed with the mineral (a kind of granite used for building and ornamental purposes, especially in St. Petersburg) in order to form good glass.

**Utilisation of Exhausted and Sliced-Up Beet-Roots as Fodder.**—Dr. C. O. Tech.—This paper is chiefly interesting to beet-root sugar makers who apply the so-called Robert's method of juice extraction.

Second February number.

This number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

**Improved Pyrometer.**—C. Bock.—To this paper, and the following—

**Control Thermometer.**—Th. Oeehelle.—The engravings are required for the proper understanding of the subjects described.

**Changes and Alterations Coal Undergoes by Exposure to Air.**—Dr. E. Richters.—We can only quote the titles of the different sections this highly-interesting paper has been divided into, viz.:—Chemical process of the oxidation of coals; influence of heat on the process of oxidation; influence of moisture upon the oxidation; influence of light upon this process.

**Possibility of the Application of Gas to Blast Furnaces.**—C. Schinz.

**Bleaching of Wool.**—Dr. H. Grothe.

**Activity (Wirksamkeit) of Amorphous Phosphorus for Safety Matches.**—W. Zettel.—A paper of special interest only to lucifer match makers.

**Schlickeysen's System of Improving Peat.**—R. Schmidt.

**Coating of Brass with Bismuth.**—C. Puscher.—Add, to a solution of nitrate of bismuth, made with 16.66 grms. of that metal, 33.32 grms. of purified cream of tartar dissolved in boiling water, and add from 50 to about 67 grms. of previously-pulverised bismuth. Place the brass objects to be coated over into this fluid while boiling, and, in a short time, a brilliant silvery white strongly and firmly-adhesive coating of bismuth will be deposited.

## NOTES AND QUERIES.

**Glycerine.**—"Subscriber" is referred to pages 71 and 167 of our 19th volume.

**Volatilising Common Salt.**—(Reply to "Enquirer.")—Common salt is readily volatilised in the presence of aqueous vapours, and is by no means a non-volatile substance, even at temperatures short of red heat.

**Barwood-Red and Indigo-Blue.**—Perhaps some of your numerous correspondents would favour me with the best modes of producing the above on cotton cloth, both as regards brilliancy of colour and economical production.—CHEMICUS.

**Dr. Schiebler's Apparatus.**—If W. R. will refer to the new edition of Fresenius's "Quantitative Analysis," under "Carbonic Acid Estimation" he will find a description and figure occupying three pages.—A. V.

**Detection of Linseed Oil in Rape Oil.**—(Reply to B. Ludlow.)—See CHEMICAL NEWS, vol. xix., pp. 238 and 252. There does not exist, as far as we have been able to ascertain a special work on oils, either in the English or any other language.

**Native Crystalline Phosphates.**—Apatite occurs, in the crystalline state in various forms, and so do other phosphates; and therefore the statement made by Mr. Hutton, in reference to the Canadian phosphate, should be taken in a less decided and exclusive manner. Any work on mineralogy will prove the existence of a variety of native crystalline phosphates.—T. A.

**Dinitrobenzol.**—(Reply to W. H. W.)—There is no doubt that the methods for preparing this compound as described by Dr. Miller and Dr. Watts, are as good as any; if you desire others, you should peruse such periodicals as the *Bulletin de la Société Chimique de Paris*, the *Annalen der Chemie und Pharmacie*, and the *Zeitschrift für Chemie von Beilstein*, all of which you may inspect at the Library of the Commissioners of Patents.

**Hardness of Water.**—(Reply to W. R.)—A water of 15 and 4-10ths degrees would require 31 measures of soap, but if diluted to twice its volume, it would require 34 measures of soap. Take another instance: the standard water, if diluted to twice its volume, would require 35 measures of soap. The extra quantity of soap used, after

diluting, represents the hardness of the pure water added. Selenite is preferable to calcium chloride for the standard water, as it requires no preparation; when finely powdered, it readily dissolves. A useful table will be found in the new edition of Fresenius's "Quantitative Analysis," which is an expansion of Clark's, and saves all trouble of calculation; it gives the soap-test required from 5° to 16°, at intervals of 1-10th degree.

## MEETINGS FOR THE WEEK.

MONDAY, April 11th.—Medical, 8.

— London Institution, 4.

— Geographical, 8.30.

TUESDAY, 12th.—Photographie, 8.

— Institution of Civil Engineers, 8.

— Ethnological, 8.

WEDNESDAY, 13th.—Geological, 8.

— Microscopical, 8.

THURSDAY, 14th.—London Institution, 7.30.

SATURDAY, 16th.—Quekett Microscopical Club. Excursion to Barnes. To meet at Waterloo Station (Richmond line), at 2 p.m.

## CHEMISTRY CHAIR IN ANDERSON'S UNIVERSITY.

TO THE TRUSTEES AND MANAGERS.

Gentlemen,—As a Professor to fill the present vacant Chair of Chemistry in Anderson's University is likely soon to be appointed, and as it is my intention to become a Candidate, I take the liberty of addressing a few statements to you as preliminary to sending in testimonials, &c.

I at present hold the appointments of Lecturer on Chemistry to the Glasgow Mechanics' Institution and Professor of Chemistry in the Glasgow Veterinary College. The former I received upwards of four years ago, when five candidates came forward; and the latter appointment I obtained, also four years ago, on the recommendation of the late Professor Penny, who was for many years chemical teacher in both institutions—and on his resignation of the Professorship in the Veterinary College, it was mainly through him that I was appointed in his place.

About five years ago, the Faculty of Physicians and Surgeons of this city deputed two of its members to report on my Chemical capabilities; and the result was a grant from that body recognising my lectures and practical classes as qualifying for examination before their board, and all other boards, &c., which recognise the Chemical teacher's certificates of Anderson's University.

I received my Chemical training in Edinburgh College of Surgeons, under Dr. Macadam, where I remained upwards of seven years. During much of that time I was Senior Assistant and Demonstrator, and had charge of large classes of both medical and manufacturing students. The analyses of medical and technical products were made daily by me in Dr. Macadam's laboratory.

On my coming to Glasgow to open a laboratory of my own, which I did in Ingram Street, I found the field of work extensive enough, but so well taken up by other Chemists that little could be accomplished for a year. My appointments to the Mechanics' Institution and Veterinary College, as Chemical teacher, opened a road; and by no small amount of energy and perseverance I have now the satisfaction of possessing the largest Practical Chemistry Classes in the city.

I have lectured daily, and held practical classes, in my laboratory and lecture-rooms and out of them, for five years, since I came to Glasgow. As you are already aware, I have expended large sums of money in fitting up my laboratories, &c., with apparatus suitable to the advancement of classes in Technical Chemistry.

The number of medical students who have attended my lectures and classes has been considerable, and at the present time at the Practical Medical Class there are twenty-one students. This number, when it is remembered the disadvantages the additional teacher must be under, who is some distance from the Andersonian, is highly gratifying.

It is out of place at this time to refer to personal scientific researches and discoveries; but, as indicating that I have not been backward in adding to Chemical facts, I may mention Oleography, Water Analysis, Free Sulphuric Acid, Manure Analysis, Detection of Strychnine, Blood Stains, Wood Paper, as some amongst my original investigations.

The departments of Scientific, Medical, and Technical Chemistry occupy my entire attention, and perhaps the best evidence of work done satisfactorily is in the fact of having enrolled, during three sessions, upwards of 500 practical students, and these at fees considerably higher than at any laboratory in the city; while the number of lecture students was 313. These numbers chiefly represent manufacturing students.

Should I have the honour to be elected by you, I shall endeavour to hold the appointment with acceptance.

I beg to place before you these statements, and I shall consider it a great favour to have your support at the time of the appointment.

I am, Gentlemen, yours respectfully,

R. CARTER MOFFAT, PH.D.

Analytical Laboratory, and School of Technical  
and Medical Chemistry,  
Mechanics' Institution, 38, Bath Street, Glasgow.



# THE CHEMICAL NEWS.

VOL. XXI. No. 542.

## ON THE RELATION BETWEEN THE SUN'S ALTITUDE AND THE CHEMICAL INTENSITY OF TOTAL DAYLIGHT IN A CLOUDLESS SKY.\*

By HENRY E. ROSCOE, F.R.S., &c., and T. E. THORPE,  
Ph.D., &c.

IN this communication, the authors give the results of a series of determinations of the chemical intensity of total daylight, made in the autumn of 1867, on the flat plateau of the River Tagus, about  $8\frac{1}{2}$  miles S. E. of Lisbon, under a cloudless sky, with the object of ascertaining the relation existing between the solar altitude and the chemical intensity of the light.

The experiments were made as follows:—1. The chemical action of total daylight was observed in the ordinary manner; 2. The chemical action of the diffused daylight was then observed, by throwing on to the exposed paper the shadow of a small, blackened brass ball, placed at such a distance that its apparent diameter, seen from the position of the paper, was slightly larger than that of the sun's disk; 3. Observation No. 1 repeated; 4. Observation No. 2 repeated. Next, the means of observations 1 to 4 were taken. The sun's altitude was determined by a sextant and artificial horizon. One of the sets of 134 observations was made as nearly as possible every hour.

It has been already pointed out, and proved by experiments made at Kew, that the mean chemical intensity of total daylight, for the hours equidistant from noon, is constant. The results of the present series of experiments prove that this conclusion holds good generally. One of the chief results arrived at is that, although the chemical intensity for the same altitude, at different places and at different times of the year, varies according to the varying transparency of the atmosphere, yet the relation, at the same place, between altitude and intensity is always represented by a straight line.

## ON THE ACIDS CONTAINED IN CRAB OIL.†

By WILLIAM J. WONFOR,  
Student in the Laboratory of the Government School of Science,  
Dublin.

CRAB oil is obtained from the nuts of a tree known botanically as *Hylocarpus carapa*, and also as *Carapa Guianensis*. This tree grows abundantly in the forests of British (also of Netherland's) Guiana. The oil is prepared from the kernels, by boiling them for some time in water, and then placing them in heaps, and leaving them for some days. They are next skinned, and afterwards triturated in wooden mortars, until reduced to a paste, which is spread out on inclined boards, and exposed to the sun: the oil is thus melted out, and trickles into receiving vessels.

The author obtained the oil as met with in the country it is prepared in, by native Indians, and hence by rather primitive and unskilful methods. It is a semi-fluid, butyraceous mass, evolving a penetrating odour. The

oil melts at  $55^{\circ}$ . In order to obtain the acids, the oil was saponified with a solution of potassic hydrate, and the soap obtained dissolved in a large quantity of water, to which solution of sodic chloride was added in excess. The soap thus separated was washed, and again dissolved in water, and that solution decomposed by means of hydrochloric acid. The liberated fatty acids were collected and pressed, and, after having been carefully freed from any sodic chloride, again saponified, and the same treatment repeated; and the soda-soap obtained decomposed with tartaric acid. The melting-point of the mixed acids was  $40^{\circ}$ .

The author describes, further, at great length, the purification of the acid, and states that its melting-point is  $57^{\circ}$ .

The acid presents the appearance of a white, glistening mass, which, on being submitted to organic elementary analysis, gave, in 100 parts:—Carbon, 75.00; hydrogen, 12.50; oxygen, 12.50. Formula,  $C_{16}H_{32}O_2$ . The composition of the argentic palmitate is,  $C_{16}H_{31}O_2Ag$ .

The author also prepared the ethylic palmitate,  $C_{16}H_{31}(C_2H_5)O_2$ , and also describes a baric salt. He further states that, for various reasons, he was, to his regret, not enabled to examine quite satisfactorily the acid of the lower melting-point contained in the original saponified and purified mass.

## ON THE CHEMICAL EQUILIBRIUM BETWEEN CARBON, HYDROGEN, AND OXYGEN.

By M. BERTHELOT.

THE following facts are the result of experiments on decomposition of carbonic acid, steam, and the prolonged reaction of the spark on sundry mixtures of hydrogen, oxide of carbon, oxygen, steam, and carbonic acid.

1. *Decomposition of Carbonic Acid*.—This gas, when traversed by a series of induction-sparks, decomposes rapidly. The decomposition reaches a certain limit, then retrogrades, again augments, diminishes, and so on, without tending towards any fixed limit. This is shown by the following table, which demonstrates the volume of gases non-absorbable by potash (oxide of carbon, and oxygen) contained in 100 volumes of the mixture under analysis. The experiment was conducted with 200 c.c. of gas, the sparks, which were strong and slow, proceeding from a Ruhmkorff coil fed by six elements of Bunsen. The specimens were taken and analysed from time to time.

After 5 minutes			After 99 minutes		
12	..	13.0	110	..	7.0
14	..	10.0	128	..	6.0
24	..	9.5	143	..	5.0
39	..	7.5	153	..	7.0
54	..	5.5	163	..	10.0
84	..	10.0			
		12.5			

The relation 2—1 between the oxide of carbon and the oxygen was verified every time; it exists only when the spark plays between platinum wires placed at a great distance from the mercury, otherwise part of the oxygen is absorbed by the latter. All this tends to establish the important fact that the decomposition of carbonic acid does not tend towards any fixed limit; this is contrary to what occurs during the decomposition of acetylene and many other reactions. This absence of a fixed limit indicates the simultaneous existence of two contrary but independent causes. Of this more anon.

2. The extreme limits between which the decomposition oscillates have no elements of constancy; all depends on the length and intensity of the sparks, as a comparison of the preceding table with the following will show.

\* Abstract of a paper communicated to the Royal Society.

† Abstract of a paper read before the Royal Society. Communicated by Dr. Maxwell Simpson.



	Short sparks.	Very short and feeble sparks.*
After 10 minutes..	14.0	—
„ 15 „	—	6.0
„ 25 „	18.0	—
„ 37 „	19.0	13.5
„ 60 „	1.5	29.0
„ 82 „	24.0	2.0

\* Two elements of Bunsen.

These figures show progressive decomposition followed by re-combination.

3. A mixture of 2 volumes of oxide of carbon and 1 volume of oxygen, with a suitable quantity of carbonic acid, does not explode. It is only necessary that the carbonic acid should constitute 60 or 65 hundredths of the entire volume. The limit is still somewhat uncertain, according to the intensity of the sparks. The re-united oxide of carbon and oxygen form, in this instance, from 35 to 40 hundredths of the entire mass.

My next researches related to the limits of the composition of explosive mixtures formed of oxide of carbon and oxygen.

4. I first of all verified the observations of Dalton, according to whom explosion does not occur in the mixture of the two gases containing less than the fifth, or more than the 14-15ths of its volume of oxide of carbon. These limits vary slightly with the intensity of the spark; moreover, in the same mixture, the combustion is sometimes complete and sometimes incomplete. For instance, a mixture formed of—

Oxide of carbon .. .. 18.6

Oxygen .. .. 81.4

burnt with flame, all the oxide of carbon being changed into carbonic acid in one experiment; while, in another, only 10.0 of it was formed. The result was similar in limited mixtures in which oxide of carbon predominated, or even oxide of carbon and oxygen in the presence of excess of carbonic acid. These variations are due to the cooling action of the excess of gas.

5. Can combination be produced below the limit of explosive combustion, and to what extent? It is only known that, at a certain distance within that limit, the combination is explosive and complete, whilst, at a certain distance beyond it, no combination is appreciable under the influence of a single spark.

Now I have perceived that, in all mixtures of oxide of carbon and oxygen beyond the point of explosion, the combination takes place under the influence of a current of prolonged sparks, and that it is completely effected, whatever may be the excess of oxygen or oxide of carbon; for instance, in a mixture formed of—

Oxide of carbon .. .. 13.0

Oxygen .. .. 87.0

a current of strong sparks, prolonged during a minute, was sufficient to form 6.5 of carbonic acid; in five minutes, this figure was increased to 13.0. The result was the same with sundry mixtures containing 8.0 and 5.0 of oxide of carbon; the same with mixtures in which oxide of carbon predominated, the oxygen being 3.3 and 1.0, only in the case of these latter more time was required to complete the action. These different results furnish the types of a progressive action, which tends to a complete combination under homogeneous systems.

6. In order to establish the fact more fully, I also worked upon the reciprocal systems, which resulted in complete reaction, whatever were the mixtures of carbonic acid and oxygen, or carbonic acid and oxide of carbon, whose composition approximates to that of systems corresponding to the limit of explosive combustion. Such are the following—

Carbonic acid .. .. 16.6 | Carbonic acid .. .. 13.0  
Oxygen .. .. 83.4 | Oxide of carbon .. .. 87.0

After being subjected to the sparks for one hour, I discovered exactly the same volume of carbonic acid; therefore the presence of a suitable excess of oxygen or oxide of carbon completely hinders decomposition.

7. It is altogether different in cases where oxygen or oxide of carbon are contained in the mixture in only slight proportions; for instance, a mixture consisting of 96.5 of carbonic acid and 3.5 of oxide of carbon, when subjected to a current of sparks for a quarter of an hour, augmented to 5.1, by reason of the formation of 3.4 of oxide of carbon and 1.7 of oxygen.

Mixtures in which carbonic oxide is mingled at once with oxide of carbon and oxygen, in the proportion of 2 volumes of one to 1 of the other, behave in a particular way; they are reciprocal with those which ensue from the decomposition of carbonic acid, and furnish the same results for an equivalent compound. Thus, the carbonic acid forming less than 60-100ths, the combination is complete and explosive, as has been already stated. Below 60-100ths, the combination is partial, always incomplete, and does not tend towards any fixed limit.—*Comptes Rendus*, vol. lxxviii., p. 1035.

#### ON THE DETERMINATION OF PHOSPHORIC ACID.\*

By WILLIAM CARLETON WILLIAMS,  
Student in the Laboratory of Owens College.

OF the many methods proposed for the separation of phosphoric acid from the alkaline earths, few are better than the one devised by W. Reissig, founded upon a process originally described by Reynoso. This method, although used in many Germany laboratories, has, strange to say, found but little favour among English chemists. This is probably owing to the somewhat complicated and tedious nature of the operations required. The modifications described in the following communication considerably simplify the process, and may, possibly, lead to its more general adoption.

Reissig's method depends upon the fact that, when metallic tin is added in excess to a solution of the phosphate of the alkaline earths in nitric acid, the stannic acid formed by the oxidation of the metal combines with the phosphoric acid and completely removes it from solution. On filtering, therefore, we at once separate the alkaline earths which remain in solution from the insoluble combination of stannic and phosphoric acids. In order to determine the amount of phosphoric acid contained in the tin oxide, the compound is dissolved in a small quantity of concentrated potash solution, when the two acids dissolve as meta-stannate and phosphate of potassium; the fluid is now saturated with hydrogen sulphide, a small quantity of ammonium pentasulphide added, and, lastly, a slight excess of acetic acid. The tin sulphide is then separated by filtration; all the phosphoric acid is contained in the filtrate, and its amount may be determined by the ordinary method as magnesium ammonium phosphate.

The chief disadvantage of this method arises from the necessity of employing a large excess of metallic tin, in order to completely remove the phosphoric acid from solution. The bulk of tin sulphide obtained is, therefore, very large, and its filtration and washing is an exceedingly long and tedious operation. In order to shorten the process, Reissig recommends that the alkaline solution of the phosphate and stannate be transferred to a weighed flask of 1000 cubic capacity, and then diluted with water until the fluid measures about 900 cubic; the solution is next saturated with hydrogen sulphide, then ammonium sulphide and acetic acid in slight excess added, and the tincture diluted until the whole weighs 1000 grms. After standing for a few hours the clear supernatant liquid is carefully poured through a filter, taking care not to disturb the precipitate. In the filtrate the phosphoric acid is estimated as magnesium pyrophosphate. The

\* Read before the Manchester Literary and Philosophical Society, March 22, 1870. Communicated by Prof. Roscoe, Ph.D., F.R.S.



amount of the fluid employed in the determination is ascertained by again weighing the flask. On subtracting the weight of the tin-sulphide calculated from the quantity of the metal originally employed, we have all the data required to determine the amount of phosphoric acid in the entire solution.

This method of proceeding is not altogether faultless in principle. (1) It pre-supposes that from a known weight of tin-foil we are able to calculate the amount of tin-sulphide it will yield. Now the tin-foil of commerce is seldom or never pure, it almost invariably contains a considerable porportion of lead, often amounting to one-third of its weight,\* and this of course passes into the nitric acid solution of the alkaline earths. (2) Since only a portion of the phosphoric acid present is actually weighed, the remainder being deduced by calculation, the chances of ultimate error are considerably increased.

These sources of error are removed by simply filtering and washing the tin-sulphide by means of the Bunsen "water-pump," an operation of comparative short duration. We thus obtain the whole quantity of phosphoric acid in solution, and entirely obviate the numerous weighings, involving, too, the very uncertain correction for the amount of tin-sulphide present.

In order to test the trustworthiness of the method thus modified, the following experiments were undertaken. A quantity of pure calcium phosphate was prepared by adding calcium chloride to an excess of sodium phosphate, and the precipitate washed, dried and ignited. About 0.5 gm. of this compound was weighed out into a porcelain basin, and dissolved in a small quantity of nitric acid; the solution was then concentrated, and the strongest nitric acid (boiling at 86° C.) added until the calcium nitrate commenced to separate out. This was immediately redissolved by the addition of a few drops of dilute nitric acid. The nitric acid solution is now in the highest possible state of concentration: on throwing a small quantity of tin into this solution, the metal is rapidly oxidised to stannic acid, and the supernatant liquid remains perfectly clear. The preliminary heating of the solution is indispensable, since in the cold the metal is apt to become passive, when it completely resists the action of the acid. The precipitate is now dissolved in a small quantity of caustic potash, and saturated with hydrogen sulphide; on adding acetic acid in slight excess the tin-sulphide is precipitated. The precipitate is then separated by means of the Bunsen "filter-pump," and the whole of the phosphoric acid is contained in the filtrate. After concentrating the solution, and again filtering from a minute precipitate of tin-sulphide, which invariably separates out (tin-sulphide being slightly soluble in solutions containing hydrogen sulphide), the phosphoric acid may be precipitated as the magnesium ammonium salt, and weighed as pyrophosphate.

I. Ratio of tin to phosphoric acid, 4 to 1.

I. 0.5135 gm. cal. phos. gave 0.405 = 50.45 per cent  
II. 0.447 " " " 0.358 = 50.78 " "

Mean .. .. 50.61 " "

The lime was determined as caustic lime after removal of the lead by means of hydrogen sulphide. The mean of two concordant analyses gave 49.65 per cent of lime.

Hence the composition of the calcium phosphate is—

Phosphoric acid	..	..	..	..	50.61
Lime	..	..	..	..	49.65
					100.26

It is, therefore, evident that the amount of pure tin required need not exceed four times the weight of phosphoric acid present.

The following experiments show that this is, moreover, the minimum quantity that can be used.

\* The tin-foil employed in my experiments contained 31.35 per cent lead.

II. Ratio of tin to phosphoric acid = 3.0 to 1.

$Mg_2P_2O_7$   $P_2O_5$   
0.477 gm. cal. phos. gave 0.307 = 41.53 per cent

III. Ratio of tin to phosphoric acid = 3.5 to 1.

$Mg_2P_2O_7$   $P_2O_5$   
0.598 gm. cal. phos. gave 0.388 = 41.50 per cent  
0.434 " " " 0.304 = 44.82 " "

In order to confirm the above results I have determined the proportion of lime and phosphoric acid contained in the calcium phosphate employed in the analyses, by dissolving the compound in hydrochloric acid, and adding sufficient sulphuric acid to precipitate the base. To each volume of the liquid two volumes of alcohol were added, and the mixture allowed to stand about twelve hours, when it was filtered and the precipitate thoroughly washed with alcohol. The filtrate containing the phosphoric acid is evaporated to dryness, the residue dissolved in water, and the acid precipitated as the magnesium ammonium salt. The lime was weighed as sulphate.

I. 0.525 gm. gave 0.411  $MgP_2O_7$  = 50.08 per cent  $P_2O_5$

II. 0.507 " " 0.396 " = 49.96 per cent  $P_2O_5$

The lime amounted to 50 per cent. Hence the composition of the calcium phosphate is—

$P_2O_5$	..	..	..	..	..	50.02
CaO	..	..	..	..	..	50.00
						100.02

exactly agreeing with the determinations made by the tin method.

## ON MICROSCOPICAL MANIPULATION.

By W. T. SUFFOLK, F.R.M.S.

(Concluded from p. 158.)

### LESSON VI. (continued).

THE length of cotton-fibre (*staple*) is determined by drawing out a tuft of the cotton repeatedly between the fingers, until the hairs are laid parallel, and then measuring the length of the tuft. This is the mode of measurement in use among cotton-brokers. An easy and accurate method of measuring single fibres of cotton had long been a desideratum in analytical operations. In 1862, Captain C. J. Mitchell, of the Government Central Museum, Madras, writes, respecting a process he had used for this purpose:—"It is exceedingly tedious, and very trying to both eyes and head." Shortly afterwards, the author endeavoured to measure single fibres by fixing them with gum upon a glass slide, making a drawing with the camera-lucida, and measuring the curved line so obtained with a map-measurer. The enlarged drawing was from 18 inches to 2 feet in length. The chief objection to this process was the amount of time occupied in the investigation, ordinary micro-metrical operations not being applicable, on account of the great length of the fibres and the impossibility of measuring them as straight lines; hence the necessity of making drawings, and following all the curves with the little measuring-wheel. A simple and accurate process has been invented by Mr. C. O'Neill, and is described by him in a communication to the Literary and Philosophical Society of Manchester ("Memoirs," 1863—4, p. 389). The apparatus employed consists of a plate of glass, on which is ruled a scale 2 inches long, divided into tenths, a pair of fine forceps, and two camel-hair pencils. The scale is laid upon a piece of black cloth, and well lighted, by daylight or a lamp, with condensing-



lens. The fibres are selected, and held by the forceps, and, with one of the pencils, moistened in the mouth, pressed and drawn out on the glass plate; the forceps are then dropped, and the other pencil brought into use to lay out the fibre, the length of which is then read off. The operation requires considerable practice, but, when acquired, single fibres can be measured to 0.05 inch with sufficient rapidity for analytical purposes. As some cotton-fibres—such as Sea Island—reach the length of 2 inches, it is well to have the scale extended to 3 inches: this will also prevent the necessity of being careful about placing the fibre on the beginning of the scale, as there will be plenty of space. And it is convenient to have a scale of about the same length divided into millimetres. For comparison with Continental observations, Mr. O'Neill gives the following results of some observations on the length of cotton-fibres:—

	Maximum. in.		Mean. in.		Minimum. in.
Sea Island .. ..	2.00	..	1.6800	..	1.35
Another sample	2.05	..	1.4440	..	1.10
Queensland .. ..	1.95	..	1.5010	..	1.10
Egyptian .. ..	1.55	..	1.2520	..	0.95
Pernambuco .. ..	1.50	..	1.6750	..	0.75
Surat .. ..	1.15	..	0.9425	..	0.75
Another sample	1.10	..	0.9250	..	0.55
Another sample	1.05	..	0.9050	..	0.70

In another communication (1862-3, p. 389), Mr. O'Neill describes an ingenious instrument for measuring the tensile-strength of fibres. The following are some of the mean breaking-weights of single cotton-fibres:—

			grs.
Sea Island .. ..	..	..	83.9
Another sample	..	..	90.0
Surat .. ..	..	..	105.8
Another sample	..	..	141.9
Egyptian .. ..	..	..	108.0
Another sample	..	..	127.0
Pernambuco .. ..	..	..	140.0

These determinations are of great value to the manufacturer. And those intending to make textile fabrics their study would do well to consult Mr. O'Neill's papers.

The amount of twisting in a thread is a very important element in the estimation of its strength. The famed Dacca muslins owe much of their superiority in lightness\* and strength to the tightness of the twist in the delicate filaments of which they are composed. This has been determined by Dr. J. F. Watson, who gives the following as the average number of twists per inch in four samples of muslin:—French, 68.8; English, 56.6; Dacca, 110.1; Dacca (another sample), 80.7. The whole subject is carefully worked out by Dr. Watson in "The Textile Manufactures and Costumes of the People of India," pp. 59—74.

Cotton is mixed with other fibres legitimately in the well-known "union cloth," a compound of flax and cotton, and as an adulteration, with woollen fabrics, and in some specimens of lint.

Silk will be found to burn differently from the fibres of the two classes hitherto considered. It curls up, and ultimately fuses and burns, giving off the disagreeable odour common to animal tissues, as hair, wool, feathers, &c. The fibres depolarise

light, giving more or less colour, but do not exhibit any structural peculiarities. Silk is entirely dissolved when boiled in strong solutions of caustic potash or soda. If cautiously heated on a slide in a strong solution of soda, the fibres will be found to swell, and bulge out in parts.

Admixtures of other fibres with silk are easily detected, by the appearance of the unravelled threads, under the microscope. The material most commonly used to adulterate silk is jute. The microscopical characters of this fibre are not of a very marked description. It is best distinguished by examining the residue under the microscope after the sample has been boiled in a strong caustic alkaline solution. Specimens of silk, breaking and fraying when pressed into tight folds, may always be suspected of containing jute: the beautiful gloss of this fibre, when carefully prepared, is the reason of its selection as an adulterating material.

*Wool.*—As already observed, this fibre presents very marked structural peculiarities. In burning, the same phenomena are apparent as in the case of silk; it is also soluble in hot alkaline solutions. The histological nature of the surface-markings may be considered undetermined at present, the apparent imbrications being interpreted by some as scales; and in many hairs (those of some of the bats especially) this character is very marked (M. C. Cooke, *Transactions of the Quekett Microscopical Club*, vol. i., pp. 33 and 55, Plates 1, 2, and 3; article, *Hairs of Animals*, "Micrographic Dictionary," p. 330; "Carpenter," p. 704).

Two valuable communications on "Wool, Commercially and Microscopically Considered" were made by Mr. N. Burgess to the Quekett Microscopical Club. Unfortunately, only abstracts appear in the *Transactions* (vol. i., p. 23). In this paper some important points of microscopical structure, bearing upon the felting process, are noticed. It is shown that the felting qualities of wool depend upon the number of waves or curvatures in the length of a fibre, and not upon the apparent serrations or imbrications.

When heated on a slide with strong solution of soda, wool swells, the medulla or interior cellular portion becomes more distinct, and the imbrications disappear, seeming to have unfolded.

Wool is mixed with other substances in the manufacture of fabrics generally with the view of improving the texture or appearance, and not usually as an adulteration.

**Explosion of Fulminating Gold.**—We are indebted to Mr. William A. Street for the following details of a curious explosion which lately occurred at a jeweller's establishment in Syracuse. A quantity of gold scrap had been dissolved in nitric acid and precipitated by ammonia. The entire material being then placed over a register to evaporate was left there, in an earthen jar, until dried. It was then removed, and when cool, the operator, who had evidently not studied the chemistry of gold, proceeded to scrape out the dry precipitate into a sheet of paper; a serious detonation soon occurred, and pieces of the jar were driven through a thick plate-glass screen, making clear holes, without cracks, so high was their velocity. We are not told of what became of the operator, but fear the worst. It is almost superfluous to add, that if, as is probable, an excess of ammonia was added in precipitating the gold, the entire process was exactly that given in most chemical works for producing fulminating gold in its most explosive condition.—Communicated by Prof. Morton.

\* A piece of fine Dacca muslin, 1 yard wide and 10 yards 12 inches long, weighed only 1565 grains (Dr. Watson; work cited, p. 75).



# PROCEEDINGS OF SOCIETIES.

## CHEMICAL SOCIETY.

April 7th, 1870.

Professor WILLIAMSON, F.R.S., President, in the Chair.

THE following gentlemen were elected Fellows:—F. Andrews, jun., W. Martindale, A. H. Palmer.

Dr. DIVERS concluded his paper "*On the Combinations of Carbonic Acid with Ammonia and Water.*"

This elaborate and very extensive memoir does not permit of any abbreviation. Readers desiring more information are therefore referred to the *Journal of the Chemical Society*, which will, in one of the next numbers, publish Dr. Divers's investigations.

Dr. GLADSTONE communicated a paper "*On the Refraction Equivalents of the Aromatic Hydrocarbons, and their Derivatives.*"

In a previous paper (read before the Society on March 3rd), it was shown that, having ascertained the refraction equivalents of carbon, hydrogen, oxygen, nitrogen, and chlorine, the refractive values of a large number of compounds, built up by those elements, may be calculated with a close approximation to the truth. In the present paper, Dr. Gladstone treats with the exceptions to that rule. Phenyl acid, oil of bitter almonds, salicylic acid, methylic salicylate, methylic benzoate, ethylic benzoate, benzol, toluol, xylol, cumol, cymol, carvol, eugenic acid, pyridine, chinoline, aniline, nitrobenzol, chlorobenzol, naphthalin, and many others yet, give, by experiment, much higher refractive values than by calculation. A glance at the names of these exceptional substances will show that they consist of the aromatic hydrocarbons, with the bodies derived from, or related to, them. The refraction equivalents of the hydrocarbons themselves, and their chlorine substitution products, are about 6.0 above what theory requires; the compounds from creosote are a little higher still. The azotised products, and those containing C<sub>7</sub>, are very nearly 8.0 above the calculated values, and hydride of cinnamyl is well known to be among the most refractive and dispersive of bodies. To what can this increased refraction be attributed? Dr. Gladstone thought first that the hydrogen in benzol and its congeners or derivatives might have a refraction value of 3.5 as in the hydracids of the halogens. But on investigating chlorhydranil, C<sub>6</sub>Cl<sub>4</sub>O<sub>2</sub>H<sub>2</sub>, where the greater part of the hydrogen is replaced by chlorine, and where the existing hydrogen is considered not to belong to the nucleus, are fraction equivalent of 7.6, that is, about the usual amount above the theoretical value, was obtained. Dr. Gladstone is now disposed to regard the nucleus, phenyl, C<sub>6</sub>H<sub>5</sub>, as an entity, having an exceptionally great influence on the rays of light, and this augmentation of refractive power has its analogy to that change in the refraction value which certain elements (for instance, iron and phosphorus), undergo when they alter their atomicity. This entity is not destroyed by the replacement of its hydrogen by chlorine, nitric oxide, oxygen, or sulphur. When, however, this nucleus is subjected to such chemical change as to break it up, the resulting products have only the ordinary effect on light.

Taking the difference of the figures obtained by experiment, and of those by calculation, it is found that the group of essential oils give refractive values of about 2 higher than required by theory; the phenyl group about 6 above the theory; the naphthalin group about 14; and the anthracen group about 17 above the calculated figures. Now, in these groups, the carbon increases in proportion to the hydrogen, and thus it becomes probable to arrange the above substances into certain series, which Dr. Gladstone regards, however, as merely a rough sketch, and by

no means as a decided question. He hopes, at some future time, to say more on this subject.

Mr. HUNTER, of Queen's College, Belfast, communicated a paper on "*Analysis of Deep Sea Water,*" a sequel to a note read before the Society in December last.

Messrs. BOLAS and GLOVES read a note "*On the Convenient Preparation of Bromo-picric.*" They also gave preliminary announcement of the discovery of tetrabromide of carbon.

Professor How had sent a memoir "*On an Acid Feed Water from the Coal-field at Stellarton, Nova Scotia.*" The paper is chiefly remarkable by giving information of the presence of free oil of vitriol in the water which is used for feeding boilers.

For the meeting on April 21st, a lecture "*On Vanadium,*" by Professor ROSCOE, is announced.

## GLASGOW PHILOSOPHICAL SOCIETY.

(CHEMICAL SECTION).

Ordinary Meeting, March 28th, 1870.

Mr. E. C. C. STANFORD, F.C.S., Vice-President, in the Chair.

MR. T. L. PATTERSON read two papers. The first was entitled—"On a Method for Obtaining a Continuous Current of Air or Gas under Pressure, for Blowpipe and other purposes."

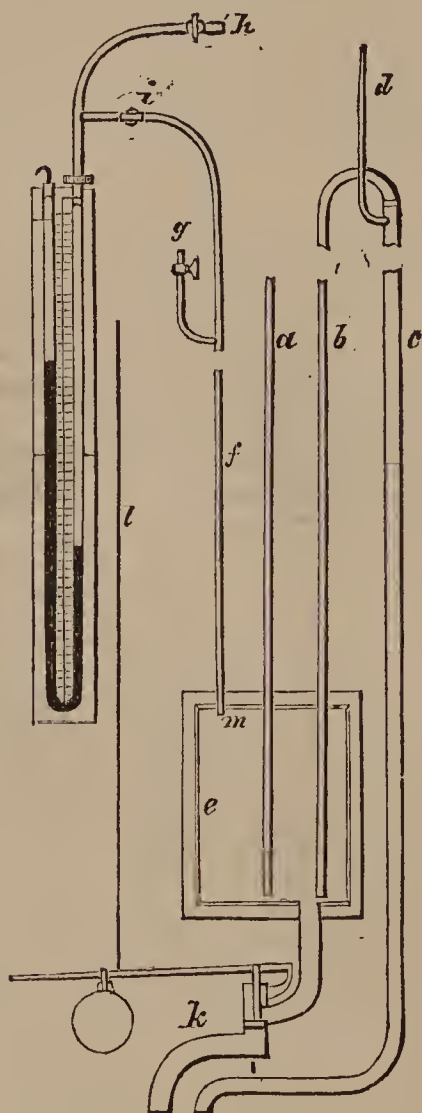
The author first explained how a continuous current of air or gas is obtained under ordinary circumstances, by the mouth blowpipe or the foot-bellows, and then mentioned the chief objections to those two methods, and proceeded to describe a method which he had found to be free from those objections. He said that it was well adapted to blowpipe work, and that he could easily obtain a pressure equal to half an atmosphere by means of it. The principle involved is the same as the Catalan blowpipe of Sprengel, and is wrought in connection with a Bunsen filter-pump, although it may be erected separately. The air-tap of a Bunsen pump being opened, the water is turned on, and air passes with the water down a long pipe, of 30 to 35 feet, in a continuous stream of bubbles. By receiving the stream into a bottle or other vessel, made air-tight with a cork, through which two tubes are passed, one nearly to the bottom of the vessel and the other just through the cork, the water will flow off by the deep tube, and air escape by the upper; and, by placing a stopcock on the upper tube, to regulate the escape of the air, the pressure in the vessel may be made equal to the height of the water-tube. The apparatus, as used by Mr. Patterson, is made of sheet-lead and "compo" pipes. Its arrangement is shown in the accompanying sketch. The internal diameter of the water-pipes is  $\frac{1}{2}$  inch, and of the air-pipes  $\frac{1}{4}$  inch.

At *a* is shown the exhaust-pipe of the pump; it reaches to within  $\frac{3}{4}$  of an inch of the bottom of the leaden vessel, *c*, which is 9 inches square and 1 foot high. This vessel, or *accumulator* is enclosed in a wooden box, by which its sides are supported. Two holes are pierced through the top, at opposite corners, and through one the water-pipe, *b*, passes to within  $\frac{3}{4}$  of an inch of the bottom, and made air-tight. It is carried up along side of the exhaust-pipe as high as is necessary for the desired pressure, and then bent back, and soldered into a 1-inch pipe, *c*, which returns, and carries the overflow-water from the pressure-pipe, *b*, to the sewer. At *d* is shown a short piece of  $\frac{1}{4}$ -inch pipe, fixed into the waste-pipe, *c*, so that the latter may not act as a syphon. Into the other hole in the leaden vessel, *c*, a piece of  $\frac{1}{4}$ -inch pipe, *f*, long enough to reach to the laboratory, is soldered air-tight. One or more communications, as at *g*, may be taken off the pipe *f* to convenient places in the laboratory, and the pipe



itself is continued to the same manometer as is used to show the vacuum obtained by the pump. Just before the vacuum and pressure pipes unite, however, there is a cock soldered into each, so that, when the pump is working, the vacuum-cock, *h*, is open and the pressure-cock, *i*, is shut—the reverse being the case when the pressure apparatus is required. The mercury in the manometer gives the vacuum or pressure in m.m.

Beneath the vessel, *e*, is placed a lever stop-cock, *k*, of 1 inch diameter, to give free exit to the water while the pump is working for a full vacuum. This cock is wrought by means of wires, *l*, and pulleys, and thus, when the water is in the laboratory, the whole apparatus is under the operator's control. The mode of operating is as follows:—The lever-cock below the accumulator is opened, the vacuum and pressure cocks adjusted, and the water is turned on; and then the mercury in the near limb of the U-tube rises, and indicates a vacuum. But, when pressure is wanted (as for a blowpipe), the lever-cock is closed, the air-pipe of the pump gently opened, the manometer gently adjusted, and, when the mercury is at the



greatest height, the air is turned on to the blowpipe by the stopcock, *g*, and then the flame will continue regular, and as long as water and air flow down the exhaust-tube. The adjustment for the flow of water is the same for the pressure as for the vacuum apparatus.

This arrangement is suitable for conducting experiments under pressure, when that is not to be greater than half an atmosphere or so. In Mr. Patterson's apparatus, the pipe only rises to a height of 13½ feet, equal to a column of mercury 303.6 m.m., or 11.95 inches. The author had no doubt that the apparatus would work well up to nearly half an atmosphere, and probably more, if the tubes could be indefinitely lengthened, as the quantity of air delivered by the apparatus in a given time varies with the difference between the lengths of the exhaust and pressure pipes. A liquid may be boiled under the constant pressure of the apparatus by placing it in a strong flask, and connecting the latter (air-tight), by means of a flexible tube, with the pressure stop-cock; or it may be distilled by connecting the receiver (made air-tight to the retort or distilling-vessel) with the pressure stop-cock, as before. It will

also be found useful for increasing filtration, by applying the pressure on the surface of the liquid to be filtered, when it is not desirable to use, or convenient to obtain, suction from beneath. Probably the most useful application of this air-current is to the blowpipe. With a Herapath lamp, it is easy, by means of the stop-cocks, to obtain a small oxidising or reducing flame suitable for chemical experiments, or the strong and powerful jet for glass-blowing and crucible operations.

The author had not tried the apparatus with a Griffin's blast gas-burner; but, from calculations made, he had no doubt that, with a Herapath lamp, he could get a blast quite as strong as that obtained by using the Griffin lamp. He stated that it would be desirable to have a float-valve at the mouth of the air-pipe, *m*, in the accumulator, to prevent the access of water into it, in the event of the apparatus at any time becoming deranged or overtaxed. In conclusion, the author explained how the apparatus might be used for delivering a steady current of any other gas not very soluble in water.

The cost of Mr. Patterson's apparatus, as fitted in connection with a Bunsen pump, is about 30s.

A discussion followed. Several members expressed themselves much interested in, and pleased with, the apparatus, as described by Mr. Patterson.

The other paper read by Mr. Patterson was, "On an Explosive Balloon."

The author gave an account of some efforts which he made some years ago to fire explosive balloons on their ascent. At first he tried the india-rubber balloons of the toy-shops. From various causes, they had failed; but the chief difficulty was doubtless the tension, which made it difficult to secure the gases. Recently, the author's attention had been directed to the collodion balloons, obtainable of the philosophical-instrument makers, believing that they would suit well, both on account of their lightness, and on account of the fact that they would wholly disappear on ignition. After a number of trials, he had found them to succeed admirably. The method adopted was as follows:—A fuse of filter-paper, about 1 inch long and ½ an inch broad, is gummed to the side of the balloon, near the mouth, and allowed to dry. The latter is then filled with a mixture of 2½ volumes of hydrogen gas and 1 volume of oxygen, the mixture being prepared in a separate vessel. The mouth of the balloon is at once tied with a piece of thread, to increase the force of the explosion. When the balloon is ready to ascend, a drop of the so-called "Greek fire" (that is, a solution of phosphorus in carbon disulphide) is placed upon the filter-paper; the thread is cut, and the balloon left to itself. In the course of half a minute or so, the explosion ensues. It is necessary to have an excess of hydrogen in the mixture, because exosmose takes place so rapidly that, by the time of ignition, the volume of that gas is sensibly reduced.

The author mentioned that, in the course of his experiments with collodion balloons, he had found a very sensible amount of heat generated in the collodion film. This he believed to be due to the oxidation of hydrogen in the pores of the collodion, somewhat similar to the action of spongy platinum or platinum-black on a mixture of the two gases.

## NOTICES OF BOOKS.

*First Report of the Commissioners Appointed in 1868 to Inquire into the Best Means of Preventing the Pollution of Rivers. (Mersey and Ribble Basins.)* Vol. i. 1870.\*

(Continued from p. 164.)

WHILE pollution of rivers by sewage is a more ordinary feature of their contamination, we need not refer here to this point any further, but prefer to lay before our readers some curious facts in relation to pollution by manufac-



turing refuse, alluded to in general terms in the following words:—

“The operations carried on in bleaching, dyeing, and printing calicoes involve the pollution of large volumes of water, partly by mineral, but chiefly by organic matters. In most cases, the colouring matters, which it is the object of the manufacturer to fix upon the tissues, are contained in but very small proportion in the dye-stuffs employed; thus the weight of actual colouring matter in 1 ton of madder is not more than  $2\frac{1}{4}$  lbs.; hence, nearly the whole of these dye-stuffs is refuse matter, which, partly in solution, and partly in the solid condition, is carried by the goit of the mill into the adjacent stream. According to Mr. Robert Hammond (Messrs. Bradshaw, Hammond, and Co.), Reddish Vale Printworks, near Stockport, who has kindly made some careful experiments for us on this point, only 25 per cent of the madder used for dyeing goes into the stream in a state of suspension; the remainder, being rendered soluble in the processes of dyeing and garancine making, consequently enters the stream in solution; hence the large proportion of organic carbon and organic nitrogen in solution in the effluent water. Mr. Hammond states that 100 tons of ground Turkey madder-root leave, after being used for dyeing,  $48\frac{1}{2}$  tons of dry spent madder; this, when made into garancine in the usual manner, and afterwards used for dyeing, leaves 25 tons of dry spent garancine. The returns show that this spent garancine is habitually put into the river or goit. With the exception of a small proportion of the mordants, and of the starch which is used in stiffening the finished goods, all the remaining chemicals find their way into the stream, since they are used in scouring, washing, and cleansing, and are not contained in the goods sent out of the factory. We may gain some idea of the extent of the pollution arising from the processes in question by considering the annual consumption of dye-stuffs, chemicals, and other materials, in one such factory of about average size. The Kinder Printing Company, at Hayfield, Derbyshire, have their works situated on the Kinder brook, a tributary of the Goyt; they employ 250 hands, and use annually—

Madder .. .. .	200 to 250 tons.
Peachwood .. .. .	3.8 tons.
Logwood .. .. .	26.0 „
Sumach .. .. .	7.9 „
Sulphuric and muriatic acids .. ..	100 to 125 tons.
Soda-ash .. .. .	50 tons.
Bleaching powder .. .. .	14 „
Lime .. .. .	about 30 „
Soap .. .. .	44 „
Liquid arseniate of soda, containing 833.2 lbs. of metallic arsenic .. ..	19 „
Cow's dung .. .. .	157 „
Starch .. .. .	49 „
British gum .. .. .	19 „

“The quantity of polluted water sent out from these works is estimated at 500,000,000 gallons per annum. It is passed through a series of small settling tanks, and then strained through canvas, to intercept the coarser particles of madder, which are either converted into garancine and re-used for dyeing, or (exceptionally in these works) put upon land, or burnt. After passing the canvas strainer, the polluted water traverses rapidly a serpentine canal 258 yards in length, and then falls into a culvert, which conveys it below the next printworks on the stream, the works of the Hayfield Printing Company.”

The result of the analytical researches made on this subject by the Commissioners show that the prominent character of this form of pollution is like that of sewage organic matter; but the organic matter of dye-water is much less highly nitrogenised than that of sewage, and is therefore, presumably, less putrescible, and, consequently, less offensive. Amongst the mineral polluting materials “of calico-printworks, arseniate of soda alone demands especial notice. About fifteen years ago, it was dis-

covered that arseniate of soda increased both the economy and efficiency of the dung-bath, and a mixture of cow's dung and arseniate of soda appears to have now to a great extent superseded the older mixtures in this part of the calico-printing process. Arseniate of soda (a compound of arsenic acid and soda, containing from 30 to 33 per cent of metallic arsenic) is excessively poisonous; and it is fortunate that the amount required in the calico-printing process is but small when compared with the vast volume of water with which it is mixed. Nevertheless, analysis reveals a very appreciable proportion of arsenic in the effluent water from printworks. Thus, the polluted water flowing from the Kinder Printing Company's works contains, in 100,000 lbs., 0.032 lb. of metallic arsenic, equivalent to 0.042 lb. of arsenious acid or white arsenic. Although this proportion is so small that it would be necessary for an individual to drink no less than 138 gallons of the water in order to imbibe a fatal dose, yet it cannot but be considered undesirable that our rivers should thus become contaminated with such a poisonous ingredient.”

The pollution by chemical works is described in the following manner:—

“The chief chemical works carried on in the basins of the Mersey and Ribble are devoted to the manufacture of soda alkali, soap, colours, and oxalic acid. The waste products are alkali waste, dilute muriatic acid (containing a considerable proportion of arsenic), burnt pyrites, chloride of manganese (containing arsenic), and chloride of calcium.

“The alkali waste is not thrown into the neighbouring river or stream, but it is stacked in enormous heaps, from which there drains a liquid containing much sulphuret of calcium in solution, and possessing an odour like that of putrid eggs.

“The burnt pyrites was formerly got rid of as rubbish, but it is now utilised, having been found to be of value as a source of copper.

“The dilute muriatic acid is, as a rule, run into the nearest stream or canal. Messrs. Crossfield, Brothers, and Co., return, as the amount of weak muriatic acid thus run away, 500,000 gallons annually (sp. gr., 1.005), which would contain about 1 per cent of real acid. Mr. A. E. Fletcher, one of the sub-inspectors under the Alkali Act, estimates the amount of free acid thus annually run to waste in the United Kingdom at 111,400 tons of real acid, or 371,133 tons of commercial liquid muriatic acid of 30 per cent strength. This is 45.5 per cent of the total quantity made.

“The chloride of manganese, though containing a valuable material, has not hitherto been utilised to any appreciable extent, and is consequently discharged into the nearest stream. Mr. Fletcher informs us that 54,000 tons of black oxide of manganese are annually consumed in the United Kingdom. Nearly the whole of this finds its way into the rivers as chloride of manganese, 57,500 tons of real muriatic acid being partly combined and partly mixed with it. According to the return of Messrs. Crossfield, Brothers, and Co., whose works are situated on the Sankey Canal, at St. Helen's, a single alkali work thus turns out, annually, as much as 1060 tons of manganese in the condition of chloride.

“The solution of sulphuret of calcium draining from the heaps of alkali waste meets, in the adjacent river, with the two waste products just mentioned, and undergoes, in contact with the dilute muriatic acid and acid chloride of manganese, a very unpleasant reaction, in which large quantities of sulphuretted hydrogen are given off into the surrounding atmosphere; some sulphur and sulphuret of arsenic are thrown into suspension as a fine mud, and the solution of sulphuret of calcium is transformed into a comparatively innocuous one of chloride of calcium. The chloride of manganese also remains in solution, and the stream continues strongly acid.

“The worst case of river pollution from alkali works that we have met with occurs in the Sankey Brook, which receives the waste products from the St. Helen's alkali



works. Between St. Helen's and Warrington, the exceedingly offensive smell of this brook can be perceived at a distance of from one to two miles from its banks. When the wind blows from the west, it always unpleasantly surprises the passengers on the London and North-Western Railway between Warrington and Kenyon Junction. Leaving injury to health out of the question, it is no exaggeration to say that this brook renders the country within two miles of its banks uninhabitable, except under a penalty of so much discomfort as few would be prevailed upon to endure."

"The results of the analysis of the pollutions from alkali works are almost entirely of a mineral character, with much free acid, and, curiously enough, free sulphur, for we read—

"A sample of the mud taken from the Sankey Brook, just before its junction with the Sankey Canal, contained, when dried at 100° C., 22.75 per cent of free sulphur. A sample of sludge that had been recently dredged from the Sankey Canal, near its junction with the Sankey Brook, contained 3.97 per cent of free sulphur after drying at 100° C. When it is remembered that sulphur is worth from £6 to £7 per ton, and that 100 tons of the dried mud of the Sankey Brook contain 22½ tons, and that nearly as much passes into the air as sulphuretted hydrogen, some conception may be formed of the vast quantity of valuable, and, as we shall presently show, recoverable material, which is thus thrown away and suffered to pollute both air and water to an intolerable degree."

It is quite impossible that, with the enormous mass of interesting details laid before us in this volume, we should be enabled to give here an exhaustive review; we cannot refrain, however, from noticing one of the curious consequences of the introduction of the use of pyrites instead of sulphur for the manufacture of sulphuric acid—

"Thus sulphur has been gradually, but at length completely, replaced by iron pyrites in the production of sulphuric acid for the alkali manufacture. Unfortunately, however, iron pyrites nearly always contains a notable quantity of arsenic, much of which passes into the sulphuric acid obtained from this material. Dr. R. Angus Smith, Your Majesty's Inspector of Alkali Works, informs us (Vol. II., "Minutes of Evidence," part 4), that 400,000 tons of iron pyrites are annually imported into this country for the alkali trade. At a moderate computation, we thus annually import 1600 tons of arsenic, a large proportion of which, there is every reason to believe, now finds its way into our rivers and streams. In the alkali factory, the sulphuric acid is employed to decompose chloride of sodium in a closed furnace. The arsenic is here transformed into chloride of arsenic, which, being volatile, passes off, to a great extent, with muriatic acid gas to the condensing towers, where it is dissolved by water and becomes a constituent of strong liquid muriatic acid, which is afterwards used in the manufacture of bleaching powder; and also of weak muriatic acid, which, as we have already described, is run directly into the nearest watercourse. The disposal, in like manner, of the arsenic in the strong muriatic acid is only postponed; it ultimately finds its way into the rivers as waste chloride of manganese liquor. But to return to the non-volatile product of the action of sulphuric acid upon chloride of sodium, technically called 'salt-cake,' which still retains a certain small proportion of the arsenic originally present in the sulphuric acid. This salt-cake is afterwards mixed with crushed chalk, or limestone and coal-dust; and the mixture is heated to incipient fusion in a reverberatory furnace. Here some of the arsenic must volatilise—indeed it might be expected that the whole of it would do so, did not the sequel prove this not to be the case; moreover, the coal-dust, which also contains arsenic, probably more than compensates for the loss. The product of this operation is termed 'black-ash.' It is afterwards lixiviated with water, and the lixivium, being evaporated to dryness, yields soda-ash. In some factories, the crystalline granules of soda-ash, as they are deposited

during evaporation, are fished out of the boiling liquor, and are afterwards sent into the market as ash of first quality. The residual liquor being evaporated to dryness constitutes ash of the lowest quality, which will contain the largest proportion of arsenic, whilst the first quality ash may be comparatively or entirely free from the poison. In a series of samples kindly supplied to us from a large chemical work, we have clearly traced the arsenic from the original iron pyrites, through the different products just enumerated, up to this point. A certain proportion of soda-ash is re-dissolved in water, and then allowed slowly to crystallise; the soda crystals thus obtained are a true carbonate of soda, and constitute the common 'washing soda' of the shops. We have examined nine samples of washing soda obtained from as many oil shops, and found that only two of them contained the poisonous metal. The bicarbonate of soda, again, of the druggist is made from the soda crystals just mentioned. Two samples of this material were examined and found to be entirely free from arsenic.

"Soda-ash is extensively used in all bleaching and scouring operations; and thus arsenic is unconsciously introduced into a vast number of factories, as, for instance, that of Messrs. Bright and Co., at Rochdale. It is employed in the manufacture of soap, but is for the most part got rid of in the spent lye of soap works, a specimen of which contained 0.325 part of arsenic in 100,000 parts; hence, of six samples of soap which we have examined, only two contained arsenic, and in but very minute quantity. As soap and washing soda are used in most households, the poisonous metal is liable to gain admission into many dwellings; it is carried by the slops into the sewers, and, in London, is afterwards found in the sewage at Barking to the extent of 0.004 in 100,000 parts.

We are by no means disposed to take an alarmist view of this wide distribution of arsenic amongst the community; indeed, as we find it to be contained in very appreciable quantity in the rain which falls in London, being derived in this case from coal smoke, it is, doubtless, present in the rain-water of all our large towns, and consequently cannot be entirely excluded from rivers; nevertheless, its unnecessary introduction cannot but be regarded as, on many grounds, undesirable; and we believe that, so far as soda-ash and its derivatives are concerned, it might be easily prevented by submitting the 'salt-cake' and 'black-ash' to a somewhat more prolonged roasting, by which the arsenic, now partially driven off, would be completely expelled. We trust that, when the presence of this impurity becomes known to alkali manufacturers, they will direct their attention to remedy the evil, introduced into their processes chiefly by the substitution of iron pyrites for sulphur."

(To be continued.)

*Proceedings of the American Pharmaceutical Association at the Seventeenth Annual Meeting, held in Chicago, Ill., September, 1869. Philadelphia. 1869.*

THIS well got up volume, containing nearly 500 pages, is a most convincing proof of the flourishing, and, at the same time, highly scientific and efficient, *status* of the pharmaceutical branch of the medical profession in the United States, and the confirmation, also, of the truth of the "E Pluribus Unum," in another and not less highly creditable sense.

Since it is entirely out of the question to give more than a very superficial account of the contents of this work, we quote from the contents the following particulars:—As might be expected from the title, a very full account is given of the meetings held during six sittings. Next follow Reports of Committees; that of the Committee on the Progress of Pharmacy being, indeed, a masterpiece of its kind, including as it does pharmacognosy, pharmaceutical chemistry, and pharmaceutical legislation. We next meet an excellent report of



the Committee of Specimens, followed by a Report on the Pharmacopœia. Among the special reports, we notice those on Pharmaceutical Glass-Ware, and on Corks (this is a very interesting paper, full of generally-useful information). Among the volunteer reports and essays, we notice the United States' Cabinet of Practical Geology and Mining; while we regret that we cannot enter into particulars on this topic, we must not omit to call the attention of our readers to the short paragraph on this subject in our issue of February 18th last (CHEMICAL NEWS, vol. xxi., p. 83). Under the title of "The St. Louis Medical Spring," by Samuel S. Garrigues, we meet with the following analysis of a mineral water accidentally discovered at a depth of 200 feet below the surface, while borings were made for finding salt at St. Louis, Gratiot Co., Mich.:—Temperature of water, 50° F.; constant sp. gr., 1.011. Total mineral matter in a gallon, in grains, 270.60, viz.,—Sulphate of lime, 66.50; silicate of lime, 6.72; chlorine (curiously enough) only a trace; bicarbonate of soda, 106.40; bicarbonate of lime, 69.40; bicarbonate of magnesia, 17.50; bicarbonate of iron, 1.20; free silica, 2.88; organic matter and loss, 2.00;—total constituents, 272.60; free carbonic acid in gallon, 6.21 (*queritur*, what—grains or cubic inches?). This water is stated to carry a current of electricity, or, perhaps, magnetism (time did not allow to specify which). Under the heading of "Michigan Salt," by the same author, we meet with the two following analyses of samples of Saginaw salts, per centically and respectively composed of—Chloride of sodium, 93.892 and 95.327; chloride of calcium, 1.446 and 0.699; chloride of magnesium, 0.771 and 0.313; moisture, 3.430 and 3.308; sulphate of lime, 0.461 and 0.363. It need hardly be said that the volume before us contains a large amount of highly-interesting well-digested and collected information in regard to pharmacy in all its relations, but space forbids us to enter into further details.

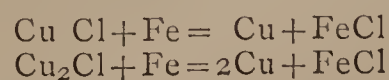
## MISCELLANEOUS.

**Opera-House Dirt.**—The dust obtained from the places of amusement in New York has recently been analysed by the scientific officers of the Metropolitan Board of Health. Over one hundred specimens of the particles floating in the air, and falling as dust, were collected on plates of glass, and were examined under the microscope. The proportions of the different ingredients varied, but the same substances were found in all the specimens. The composition of the matter subjected to the microscope was as follows:—"The dust of the streets in its finer or coarser particles, according to the height at which it had been collected, with a large proportion of organic elements; particles of sand, quartz, and feldspar; of carbon, from coal-dust and lampblack; fibres of wool and cotton of various tints; epidermic scales; granules of starch of wheat, mainly the tissues of plants; the epidermic tissue, recognised by the stomata or breathing pores; vegetable ducts and fibres, with spiral markings; vegetable hairs or down, either single or in tufts of four or eight, and of great variety, and three distinct kinds of pollens. Fungi were abundant from mere micrococcus granules to filaments of mould. When water was added to a portion of dust from whatever source, and exposed in a test tube to sunlight or heat for a few hours, vibriones and bacteria made their appearance, and the fungous elements sprouted and multiplied, showing that they maintained their vitality, and proving that the germs of fermentation and putrefaction are very widely diffused."—*Scientific American*.

**Quality of the Gas Supplied to the Metropolis.**—Dr. Letheby, the Chief Gas Examiner appointed by the Board of Trade, has reported to the Corporation of London and the Metropolitan Board of Works the quality of gas supplied to London under the provisions of the "City

of London Gas Act, 1868;" and the following are the principal results:—1. *As Regards Illuminating Power.*—This has ranged the case of common gas from 16.70 standard sperm-candles to 17.84, the average of the different companies being as follows:—City Company, 16.95 candles; Chartered, at Leadenhall Street, 17.84 candles, at Gray's Inn Road, 16.70 candles, and at Arundel Street, 17.60 candles; and the Great Central Company, 17.46 candles. The illuminating power of the Cannel gas has been 24.12 candles in the case of the Chartered Company, and 26.09 in that of the City Company. 2. *In Respect of Purity.*—Sulphuretted hydrogen has been always absent from the gas of all the Companies, except on one occasion, when it was accidental. The average amounts of sulphur in other form than sulphuretted hydrogen were as follows:—9.54 grs. per 100 cubic feet of the Cannel gas of the City Company, and 25.82 (or nearly three times as much) in that of the Chartered Company; 14.19 grs. per 100 cubic feet of the Great Central gas; 19.99 grs. in the common gas of the City Company; and 22.47 grs., 24.43 grs., and 29.31 grs. in that of the several stations of the Chartered Company. These results show that the amount of sulphur in the gas of the Chartered Company is largely in excess of that of the City and the Great Central Companies; and considering the mischievous effects of this impurity, it is highly necessary that the proportion of it should be kept down to the smallest amount. Ammonia has been always absent from the City Company's gas; but it has ranged from 0.86 of a grain per 100 cubic feet to 4.9 grs. in the gas of the Chartered Company, the average for the quarter being 0.86 gr., 1.4 grs., 3.28 grs., and 2.1 grs. in the gas at the several stations of the Chartered Company, and 2.1 grs. per 100 cubic feet of that of the Great Central Company.

**Humid Copper Process, Invented by Dr. Sterry Hunt.**—The ordinary process for the manufacture of cement-copper consists in the solution of the copper compounds (generally by means of acids) and the precipitation of the metallic copper by the addition of iron. This method is open to two objections. One is the waste of iron, resulting from the fact that, of the iron added, a part remains in solution without precipitating any copper, and another part is itself precipitated with the copper. The other objection is the contamination of the product arising from this precipitation of a portion of the iron with it. The ingenious process of Messrs. Hunt and Douglas obviates these objections by a change in the method of effecting a solution. The preliminary roasting of sulphuretted ores, and the final precipitation with metallic iron, are the same as in the ordinary process; but the chemical reactions of the solution are widely different. The evils we have alluded to arise from the acid solutions employed, and the per-salts of iron contained in them. The peroxide of iron in the bath, whether in combination with sulphuric or muriatic acid, absorbs a portion of the metallic iron, and becomes reduced to protoxide; while a portion of the per-salts falls in a basic, insoluble precipitate. These unstable per-salts should, if possible, be avoided. Again, the subchloride of copper contains twice as much copper in proportion to the chlorine as the protochloride. The ordinary precipitation substitutes iron for the copper of the protochloride, making metallic copper and protochloride of iron; but the same iron would suffice to expel 2 equivalents of copper from the dichloride. Thus—



It is evident, therefore, that the more dichloride of copper is present in the solution the less iron will be required for the precipitation. The theoretical amount required for a protochloride solution is, as we have said, 88.3 parts of iron for 100 of copper. The theoretical amount for dichloride is half as much, or 44.1 parts of iron. For mixtures of the two, the proportion of iron required by theory would vary between these two limits, according to



the proportions of the proto- and di-chloride of copper. But this desirable dichloride of copper is insoluble in water, and in the ordinary process its presence would be troublesome. The bath employed on the new process, however, permits its formation, and holds it in solution. This bath is a solution of neutral protochloride of iron, with a certain proportion of salt. The former acts upon the oxidised copper, producing a mixture of dichloride and protochloride, and precipitating at once peroxide of iron. The salt holds the copper salts in solution, and the liquid is drawn off from the insoluble residuum. From this liquid, by the addition of metallic iron, the copper is precipitated. By this means, all absorption or precipitation of iron in the last operation is avoided, and, at the same time, the theoretically-necessary quantity is reduced, since a large portion of the copper (about two-thirds) is dichloride. It is found easy in practice to produce 100 lbs. of pure cement-copper by the use of about 60 lbs. of iron.—*Engineering and Mining Journal*, U.S.A.

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

*Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

*Comptes Rendus des Séances de l'Académie des Sciences*, April 4, 1870.

Leaving the purely mathematical, mathematico-physical, and similar papers, as also those belonging to natural history, unmentioned, this number contains the following papers relating to chemistry and collateral sciences:—

**The Teacher of Descartes.**—M. Jouglet.—The author has discovered, in the Municipal Library, at Tours, an unpublished manuscript bearing title, "In Universam Logicam Moralemque Philosophiam Commentarius Authore Celeberrimo Professore Grandillonio, ex convictu Flexensi," 1619. It is a well-known fact that Descartes (Cartesius) was educated at the College at La Flèche, but his teacher's name had not hitherto been found out. The author of this paper states that the manuscript is of great value, and deserves to be printed for public use.

**Existence of Selenium in Commercial Copper.**—Ch. Violette.—In order to detect the presence of this metalloid in copper, the author oxidises the metal, previously suitably cut up, by heating it to redness in a muffle. The oxide obtained is next placed in a combustion-tube and then placed in a gas or other furnace (as applied for elementary organic analysis), and heated to strong red heat for several hours in a current of dry and pure air (freed from aqueous vapour and carbonic acid). If any selenium be present, there will appear, at the cooler portion of the tube, just outside in front of the furnace, a white-coloured ring, composed of a volatile, crystalline, very hygrometric substance, readily soluble in water, and not coloured blue on addition of ammonia, which indicates absence of copper. The aqueous solution yields an abundant precipitate with nitrate of silver, which is soluble in excess of nitric acid. Reducing agents turn this white-coloured ring into a red-coloured substance, which exhibits all the reactions of selenium. The copper operated upon was from Chili.

**Cause of the Acidity of the Water Collected in the Chloride of Calcium Bulbs Fixed to the Apparatus in Use for Elementary Organic Analysis.**—Ch. Violette.—The author's researches prove that the acidity alluded to is due, partly to hydrochloric acid, and partly to selenious acid; the former being due to the omnipresence of hydrochloric acid in the air of chemical laboratories, and, as regards the latter, the cause has just been explained.

**Formation of Formic Acid from Carbonic Acid.**—E. Royer.—The author states that, while submitting to the action of a current of electricity an aqueous solution of carbonic acid, the latter was simply, by the addition of hydrogen, converted into formic acid.

**General Theory of Chemical Action.**—M. Maumené.—Of this memoir, which was not read, the Perpetual Secretary on duty at the meeting said that it contained a critical review of the labours of MM. Friedel and Crafts on silicium-ethyl.

**Laws which Regulate the Expansion of Gases.**—J. Dubrunfaut.—One of the most prominent points of this lengthy paper is the statement made by the author that even the driest air, or any other

gas, contains always 5-10,000ths part of a gramme of aqueous vapour to the litre.

**Object-Glass Provided with a Prism to be Used with an Ophthalmoscope.**—M. Wecker and G. Roger.—By the contrivance of a prism for total reflection, the authors enable two parties to make observations simultaneously.

**Application of Polarised Light to the Photographing of Microscopically-Small Crystals of some Salts.**—J. Girard.—There was no paper read on this subject, but the photograms were exhibited.

**Newly-Published Work.**—H. de Parville.—M. J. Dumas highly eulogises the volume just published under the title of "Causeries Scientifiques" (Scientific Gossip). The eminent author reviews the recently-made progress in divers branches of science, and the applications thereof.

Although not belonging to chemistry or collateral sciences, we quote the title of the following paper, chiefly because France is indebted to M. J. Dumas for instituting this very useful *enquête* while he (now some 20 years ago) was the Minister of Agriculture, Commerce, and Public Works.

**Communication of the Cases of Rabies which have Occurred in France during the Sexennial Period, of 1863 to 1868 inclusive.**—M. Bouley.

*Revue des Cours Scientifiques de la France et de l'Etranger*, April 2, 1870.

This number does not contain any original papers or memoirs relating to chemistry or collateral sciences.

*Revue Hebdomadaire de Chimie*, March 24, 1870.

**Description of an Apparatus Suited for Heating Molasses.**—Lefèvre-Lévy.—This apparatus, illustrated by a woodcut, the author states, is highly economical, in consequence of the very small consumption of fuel, and that this apparatus is now being introduced for the heating of wines according to Pasteur's system.

**Refining of Raw Sugars, and Extraction of Crystallisable Sugars from Molasses, by means of the Suate of Hydrocarbonate of Lime.**—MM. Boivin and Loiseau.—This paper, although not a reproduction of another on the same subject, and already alluded to by us, partakes of the same defect, viz., of not lucidly and clearly describing the process, and of not in the least explaining what suate of hydrocarbonate of lime is, or how it is prepared.

**New Process for the Preparation of Nitric Ether.**—H. Lossen.—Nitric acid (sp. gr., 1.4) is heated with nitrate of urea (15 grms. to the litre) to boiling-point, and next left to become cold. 400 grms. of that acid are then taken, and mixed with 300 grms. of absolute alcohol; and thereto is added 100 grms. of nitrate of urea, and this mixture distilled from a tubulated retort. When about half the contents of the retort have been distilled over, a fresh portion of alcohol and acid is added, by means of a proper funnel-tube. The 100 grms. of nitrate of urea are sufficient for obtaining 7 litres of this ether.

*Moniteur Scientifique*, No. 319, April 1, 1870.

This number contains the following original papers and memoirs relating to chemistry and allied sciences:—

**Researches on the Ethers of Boracic Acid.\***—H. Schiff.—This most extensive monograph is divided into the following sections, the titles of which we can only quote, since the work is not suited for any useful abstraction. In the introduction, the author discusses boracic acid, of which he assumes the existence of monoboric, diboric, triboric, tetraboric, and polyboric acids, illustrated by a series of complicated formulæ. We next have—Triethylic borate; monethylic borate; monethylic triborate; Ebelmen's boric ethers; methylic derivatives of boric acid; amylic derivatives of boric acid; mixed ethers of boric acid; monomethylic borate; boric anhydride and glycerine; boric anhydride and phenic alcohol; monophenic borate; tetraphenic diborate; boric anilide; supposed combination of chloride of boron and ether.

**Adulteration of Catechu.**—J. Tissandier.—It is a well-known fact that catechu is too often adulterated; and the sophisticated substance has often injuriously affected various operations wherein it is employed, especially dyeing and calico-printing. According to this author, genuine catechu, when exhausted by means of ether, loses 53 per cent of its weight, leaving, after drying, 47 per cent of residue. A mixture of catechu and alum gives a white precipitate with nitric acid and with chloride of barium.

*Neues Jahrbuch für Pharmacie*, von Dr. F. Vorwerk, January, 1870.

This number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

**Estimation of the Value of the Various Kinds of Cinchona Bark.**—Dr. A. E. Vogl.—Forty grms. of the previously-pulverised

\*This paper is not, in the strict sense, original; but, since it has been only published in the *Giornale di Scienze Naturale ed Economiche di Palermo* (vol. v., p. 9), we quote it here.



bark are intimately mixed with 10 grms. of quick-lime, and made into a thin paste with water; and this mixture is dried (the temperature is not stated). The dried mass is pulverised, and repeatedly exhausted with boiling alcohol at 90 per cent (600 c.c. are a sufficient quantity for this purpose); the alcoholic solution is filtered, and to the filtrate are added about 5 c.c. of dilute sulphuric acid. The ensuing precipitate of gypsum having been removed by filtration, the alcoholic fluid is submitted to distillation, and, after having been greatly reduced in bulk, is further evaporated to a very small bulk on a water-bath, whereby a flocculent, resinous, vanilla-like smelling aromatic substance is precipitated. After this material is again removed by filtration, to the filtrate is added a sufficient quantity of a solution of caustic soda as is required for the precipitation of all the alkaloids contained in the bark. These bodies are, by this mode of treatment, obtained in a high degree of purity in the shape of a white caseous, or crystalline-flocculent precipitate; this should be collected on a previously-tared filter, washed with the smallest possible quantity of water, and thoroughly dried, and next weighed. In order to separate the different bases from each other, the aforesaid precipitate is digested for twenty-four hours in a small flask with about 5 c.c. of ether. The ethereal solution is filtered off from the insoluble residue, which is first washed with ether, and next dissolved in alcohol. Each of the solutions so obtained is evaporated, yielding, in some instances, an amorphous, in others, a crystalline residue. These residues are dissolved in dilute sulphuric acid; and, after these solutions have been filtered, the alkaloids are precipitated from these solutions by means of a caustic soda solution, which has been titrated so as to correspond with the dilute sulphuric acid applied as just stated. This method of the estimation of the value of the cinchona barks is recommended by the author for the reason—(1) that it is easily and rapidly executed; (2) because it affords complete exhaustion of the valuable constituents of the bark, with very little, if any, loss; (3) because the bases are obtained directly in a high degree of purity. There are appended to this paper a series of results of analyses of various kinds of barks, made partly by this and partly by other well-known methods, as devised by scientific men who, like Dr. de Vrij, Dr. Rabourdin, and Prof. Schneider, are high authorities on this subject. From the results here published, this method deserves every praise.

**On Arsenic-Free and Arsenic-Containing Aniline Colours.**—Dr. Werner-Ertel.—The main gist of this paper, which contains some rather startling and curious, yet, unfortunately, not properly specified, statements, in respect of the extensive dissemination of arsenic in some of the German rivers, as a consequence of the large consumption of arsenic in the preparation of aniline colours, is, how to obtain fuchsine, and other similar preparations, free from arsenic, so as to render these substances fit for the colouring of sweetmeats, liqueurs, syrups, and pharmaceutical preparations.

**Preparation and Qualitative Testing of Hydrate of Chloral.**—Dr. Riecker.—A lengthy, but purely pharmaceutical paper.

**Very Simple, but rather Rare, or Hitherto Undetected, Adulteration of Saffron.**—Dr. W. Hallwachs.—The author states that, when he was, towards the end of last year, performing his duty as Inspector of Pharmacy and Pharmaceutical Chemists' Shops, he met with two instances of saffron having been adulterated with chalk; a fraud, he says, not so readily perceived as would appear, since it is only found out by taking a rather large quantity of the drug and placing it in water. Upon stirring the mixture, the chalk settles down on the bottom of the vessel, and may, of course, after having been washed with water, be readily tested. The author estimated the quantity in one instance, and found 17.5 per cent by weight; he also states that, in his opinion, this adulteration of this always rather expensive drug is made at the places where the saffron is grown, in order thus to increase the weight.

**Decomposition of Ammonio-Phosphate of Magnesia.**—Dr. N. Graeger.—The author states that he is in the habit of keeping a concentrated aqueous solution of this salt for the purpose of washing therewith the precipitate of the same salt obtained in well-known analytical operations. The aqueous solution alluded to, not having been required for use for at least six months, the author, on requiring it again, was astonished to find that, on the surface of the liquid, as well as on the layer of the salt at the bottom of the bottle, there was a film of pale golden-yellowish coloured substance; on opening the vessel which contained the solution, a very strong smell of phosphuretted hydrogen appeared. The quantity of the coloured material alluded to was too small to test even qualitatively, but the author thinks it might be phosphide of magnesium. The distilled water used for making the solution was pure, but not quite free from a small quantity of organic matter.

*Annales de Chimie et de Physique*, March, 1870.

This number contains the following original papers:—

**Researches on Camphor, and on some of its Derivatives.**—H. Baubigny.—Continuation and end of a very lengthy paper.

**New Theory of the Electro-Dynamic Action.**—M. Reynard.—An algebraico-physical essay.

**Researches on the Combinations of Silicon with the Alcohol Radicals.**—C. Friedel and J. M. Crafts.—This memoir is divided into the following sections:—Silicium-ethyl; oxide of silicium-triethyl; action of bromine on silicium-ethyl; action of bromine and iodine (jointly) on silicium-ethyl; action of iodine on silicium-ethyl; action of chlorine on silicium-ethyl; acetate of silicononyl; siliconylic alcohol; constitution of silicium-ethyl-bichloride; oxidation of silicium-ethyl; silicium-methyl; silicium-ethyl-methyl.

**Experimental and Theoretical Researches on the Equilibrium Figure of a Liquid Mass which is Considered as Devoid of Weight.**—J. Plateau.—Conclusion of a very lengthy and abstruse, yet very valuable, paper on this subject.

*Bulletin de l'Académie Impériale des Sciences de St. Petersbourg*, Vol. xiv., No. 4.

This number contains only one paper relating to chemistry—

**Some of the Properties of Galvanically-Precipitated Iron.**—R. Lenz.—This lengthy paper records a series of experiments, not only made with iron, but also copper. The results are stated as follows:—Iron and copper, when reduced to the metallic state by electricity, contain gases occluded, among which, hydrogen is in largest amount; the bulk of gas thus occluded varies considerably, but iron has been found by the author to occlude as much as 185 times its own bulk. The absorption of the gases is more considerable in the first layers of metal deposited. On being heated, the iron loses gas, even below 100°, the gas evolved at so low a temperature being chiefly hydrogen. Iron which has been galvanically precipitated, and then made red-hot and cooled, becomes oxidised when put into water, that liquid being decomposed and hydrogen given off.

*Bulletin de la Société d'Encouragement pour l'Industrie Nationale*, No. 206, February, 1870.

This number is almost entirely filled with a lengthy report of the General Annual Meeting of this Society, held on the 11th of February last, under the presidency of M. J. Dumas. Among the reports of the prizes and medals given to a very large number of parties, the following may be noticed as being of general importance:—

**Distillation of Beet-Root in the Rural Districts, as Carried Out by M. Champonnois's System, to whom the Argenteuil Prize of £500 is given.**—M. Heuzé.—This is an excellent paper on a rural industry now of very great importance, not only for the production of alcohol, but also for fodder for cattle and the supply of farmyard manure.

**Pyro-Electric Gilding Invented by M. Masselotte, to whom a Prize of £20 has been given.**—M. Barral.—From the author's report, it appears that this invention is very valuable, since it possesses all the advantages of the best method of mercurial gilding, without being at all detrimental to the workmen.

**Improvements in the Methods of the Preparation of Extracts from Dye-Staffs, by M. Coez, to whom a Gold Medal has been awarded.**—This process is briefly alluded to, having been already fully described some three years ago. From what is here stated, the extracts prepared by this method are in high reputation at Mulhouse, Rouen, and Lyons.

**Animal Phosphated and Chlorinated Manure.**—A silver medal has been awarded to Dr. Groualle and Dr. Boucherie for having successfully solved the problem of utilising dead cattle—viz., dying a natural death, and converting the carcasses, in a very short time, to an excellent manure—saving the fat, and obviating any nuisance.

*Annalen der Physik und Chemie*, von Poggendorff, No. 2, 1870.

This number contains the following original papers:—

**Thermo-Chemical Researches.**—J. Thomsen.—The fourth and final part of this monograph, sub-divided into the following sections:—Boric acid; silicic acid; stannic acid; titanous acid; platinous acid (*platinsäure*); the fluorides of boron, silicium, titanium, tin, and platinum.

**Circular Polarisation in some of the Six-Membered (Sechsgliedrigen) Hyposulphates.**—C. Pape.

**Some Peculiarities Relating to the Theory of the Capillary Phenomena.**—J. Stahl.—A mathematico-physical essay.

**On the Part Capillarity Plays in the Phenomena of the Spreading Out (Ausbreitung) of Liquids.**—P. du Bois-Reymond.

**Observations and Remarks upon Two Memoirs, by MM. von Bezold and E. Edlund, on Electrical Phenomena.**—R. Clausius.

**Historical Observation on the Publication of G. Magnus treating on the Reflection of Heat.**—H. Knoblauch.

**Relations Existing between the Changes of Bulk during the Formation of Solid Compounds and the Chemical Affinity of the Component Substances.**—W. Müller.—Chiefly a series of tabulated forms, unsuited for any useful abstraction.

**Preparation of Crystallised Silicic Acid by the Dry Way.**—G. Rose.—The author records a series of experiments, chiefly of interest for mineralogy, as elucidating the formation of native crystalline silica.

**Enstatite occurring in the Meteoric Iron of Breitenbach (Bohemia).**—V. von Lang.—A purely crystallographical paper.

**Crystalline Form of Hypersthene.**—A. von Lang.—Also a crystallographical paper. Hypersthene is a mineral composed of silica alumina, protoxide of iron, protoxide of manganese, magnesia, lime and water.



**Contribution to the Ozone Question.**—O. Wolffenstein.—This essay is illustrated with engravings absolutely required for the proper understanding thereof.

**Researches on the Compounds of Selenium and Sulphur.**—A. Bettendorff and G. vom Rath.—This paper is chiefly a crystallographical essay respecting some compounds artificially obtained, the results of analysis of which are only approximatively given.

**Electrical Action of Points (Spitzenwirkung).**—Dr. J. C. Pogendorff.

**Corroded Figures (Aetzfiguren) and Asterism in Iceland Spar.**—Dr. H. Baumhauer.

*Journal für Praktische Chemie*, Nos. 22 and 23, 1869.

These numbers contain the following original papers and memoirs:—

**Contribution to our Knowledge of Selenium.**—Dr. B. Rathke.—This paper, a continuation of an essay on this subject, contains the following sections:—Estimation of selenium in organic compounds; carbide of selenium and selenium-xanthogenic acid; experiments for the preparation of selenium-tetrethyl and sulpho-tetrethyl; ethyl-selenious acid; observations concerning the organic derivatives of sulphurous and selenious acids, and also of sulphuric and selenic acids.

**Ratanhine and its Combinations.**—Dr. W. F. Gintl.—The commercial extract of rathannia contains a principle called ratanhine. The author, in the introduction to his paper, states that the substance known as angelin, and met with in the *Ferreira spectabilis*, is identical with ratanhine; and he has made use of that material (angelin) to prepare and analyse a lengthy series of compounds, among others, *ratanine ammonia*, no properly speaking constant compound of ammonia; and the substance named could be obtained, and different formulæ are quoted relating to the higher or lower temperatures at which the *pro tempore* existing compound was prepared, at 0° (32° F.). The formula is  $C_{10}H_{13}NO_3 + 19NH_3$ . Dry ratanhine does not combine with ammonia at all, if the latter be applied in the state of dry gas. There are further described a series of experiments to form compounds of ratanhine with the alkalies, soda and potassa, with baryta, strontia, lime, magnesia, and the oxides of heavier metals; the silver compound is  $C_{10}H_{11}Ag_2NO_3$ ; behaviour of ratanhine with acids; and, lastly, speculative discussions on the constitution of ratanhine.

No. 1, 1870.

With this number begins a new series of volumes of this periodical, which is edited by Dr. H. Kolbe. The number opens with a table of the numbers of the equivalents of the elements and some of their compounds, it being, of course, understood that the several authors who are contributors to this paper may make use of such equivalents as they prefer; but, unless the contrary is distinctly stated, the table here referred to is the one adopted for this periodical. We next meet with a very lengthy series of the titles and abbreviations thereof of the various scientific periodicals, as they will be quoted henceforward in this work. The present number opens with a lengthy essay on the—

**Task and Scope of Mineral Chemistry.**—H. Kolbe.—Not at all suited for abstraction.

**Identity of Naturally-Occurring Leucine with that obtained by Synthetical Methods of Preparation.**—Dr. G. Hüffner.—A physiologico-chemical paper, the leading point of which is that all the three known leucines, and obtained by different methods, are identical, and not simply isomeric.

**Some of the Derivatives of Oxysulpho-Benzide.**—J. Annaheim.—This paper is divided into the following sections:—Ethyl-oxysulpho-benzide; nitro-ethyl-oxysulpho-benzide; tetra-chloroxysulpho-benzide.

**Isomeric Succinic Acids.**—H. Byk.—A very lengthy monograph, too full of formulæ to admit of any useful abstraction.

**Crystalline Forms of Trithionate and Seleno-Trithionate of Potassa.**—B. Rathke.—A crystallographical paper, illustrated with woodcuts.

*Bibliothèque Universelle et Revue Suisse.—Archives des Sciences Physiques et Naturelles*, No. 147, 1870.

This number contains the two following original papers, of which, although not exactly belonging to chemistry, we quote the titles—

**Evaporation of Water of the Soil and of Plants.**—E. Risler.

**Dust Floating about in the Atmosphere.**—A. de la Rive.

*Cosmos*, April 2, 1870.

**Preparation of Photographic Figures on Glass.**—E. Siegwart.—This paper contains a detailed account of the various operations required for fixing upon glass various designs.

**Experiments on the Freezing of Wine.**—A. Rousselle.—The reason why freezing improves wines, under certain conditions, is, according to this author, because, by freezing the proportion of all the fixed substances (*éléments*) in wine is increased, and these are, moreover, thereby rendered more fit for causing the combination of the acids

with the alcohol, so as to form those ethers to which wine owes its peculiarly distinct flavour, aroma, and strength.

*Revue Hebdomadaire de Chimie*, March 31, 1870.

**New Plan for the Method of Estimating the Market-Value of Molasses.**—M. Mène.—This paper, chiefly of interest to beet-root sugar makers, enters, at some length, into the application of the areometer for ascertaining the value of the molasses; and next, the author discusses the plan of estimating the value of the molasses according to the alcohol it yields, stating that 100 parts of sugar should produce, in practice, 57 parts of alcohol at 90 per cent.

**Description of an Improved Barometer for Use in Chemical Laboratories.**—M. Alvergnat.—The description is not available without the woodcut; but the instrument is undoubtedly a very suitable one for the use it is intended for.

*Annalen der Chemie und Pharmacie*, February, 1870.

This number contains the following original papers and memoirs:—

**On Fermentation, and on the Source of Muscular Force.**—Dr. J. von Liebig.—The continuation and end of the celebrated author's lengthy essay on this subject, divided into the following main sections:—Acetic fermentation; the source of muscular power.

**Experimental Researches made with the view to Elucidate the Causes upon which the Substitution of the Radical Hydrogen is made Dependent in Isomeric Butyric Acids.**—Dr. Morikownikoff.—This very lengthy essay contains the following subdivisions:—Oxyisobutyric acid; researches on the different oxybutyric acids; the haloid hydrines of propylen-glycol.

**Some of the Alcohols of Fermentation and Derivatives thereof.**—J. Pierre and E. Puchot.—Not well suited for any useful abstraction.

## NOTES AND QUERIES.

**Barwood-Red and Indigo-Blue.**—(Reply to "Chemicus.")—You may consult "Die Färberei der Gespinnste und Gewerbe von Reimann" (p. 28 and following, and 210 and following), where you will find a great many practical receipts.

**Chlorate of Soda.**—I cannot succeed in making chlorate of soda satisfactorily by means of tartrate of soda and chlorate of potash. Large proportions of the two salts remain undecomposed, and I found a sample of commercial soda chlorate nearly as bad as my own.—W. H.

**Sulphate of Ammonia.**—Would you kindly tell me what proportions of sulphate of ammonia, lime, and water (say, to 1 cwt. of sulphate) are used in practice for making liquor ammonia. I have no work that gives any particulars worth naming—Watts's "Chemistry" is rather too expensive.—A WORKING MAN.

**Colouration of Glass.**—I was to-day shown a piece of glass which lately formed a part of the Land's End light-house, the lamp of which was broken by a heavy sea some time back. This glass exhibited a rather striking peculiarity, the explanation of which I seek from the courtesy of your readers. The piece in question was about 3 inches long by 2 inches broad, and  $\frac{1}{2}$  an inch thick, and was of a beautiful amethystine colour where, probably, acted upon by the light; but at the edge, where protected by putty or other sheltering material, the glass had entirely retained its white transparent hue. Not only was the surface affected in this manner, but the colouration apparently extended completely through the glass.—RIA.

[Such colouration, under the influence of light, is not uncommon when the glass contains manganese.—ED. C. N.]

## MEETINGS FOR THE WEEK.

TUESDAY, 19th.—Institution of Civil Engineers, 8.

WEDNESDAY, 20th.—Meteorological, 7.

— Society of Arts, 8.

THURSDAY, 21st.—London Institution, 7.30.

— Zoological, 4.

— Chemical, 8.

FRIDAY, 22nd.—Quekett Microscopical Club, 8.

## TO CORRESPONDENTS.

*Chemicus*.—It will not be published before the autumn.

*P. Holland* (Manchester).—Any work on Chemical Analysis will give you the information you require.

*Bichromé*.—The lead pump has not made the water hard; it has probably become so from natural causes.



# THE CHEMICAL NEWS.

VOL. XXI. No. 543.

## ON THE ETHYLIC SERIES OF SILICIUM.

By MM. C. FRIEDEL and A. LADENBURG.

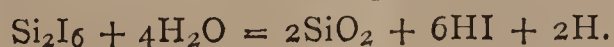
THE observations, of which an account is here given, tend to prove the truth of the opinion expressed by M. Dumas, some thirty years ago, that hydrogen was not the only element susceptible of substitution, and that some body might be found capable of replacing carbon.

Sundry articles upon the subject, written first by MM. Friedel and Crafts, and afterwards by ourselves, show, in the first place, that silicium is a tetratomic element like carbon, and deserves comparison with it on that account; but the analogy does not end here. Silicium is capable of acting after the manner of carbon, and serving as a link for several hydrocarbonised groups by furnishing bodies presenting great analogy with certain hydrocarbides, and governed by the same law of saturation, provided the silicium be reckoned as an equivalent of the carbon, atom for atom. From these siliceous hydrocarbides several bodies may be derived, whose residues, containing silicium, united with carbon and hydrogen, and play the part of radicals exactly like simply hydrocarbonised groups. After studying a large number of compounds, forming what may be called the methylic group of silicium, it was necessary to find bodies corresponding to more elevated groups of the carbon series, and thus to show that silicium in groups analogous to organic compounds, may not only be saturated by atoms of carbon, but partakes with that element the property of saturating itself at least partially. This was at last effected after numerous fruitless attempts.

Upon endeavouring to remove from chloride of silicium a portion of the chlorine contained in it, so as to change it into a chloride more complex by one molecule, the silicium will be completely reduced if a metal be employed, such as sodium, zinc, or silver. In the case of hydrogen, which was used by Ebelmen for preparing sesquichloride of titanium, only a small quantity of silicichloroform was obtained.

It was believed that the iodine of silicium,  $\text{SiI}_4$ , discovered by one of us, would be attacked at a low temperature and would thus become better adapted to the end in view; experiments have justified the supposition. The iodide was heated for some hours at a temperature approaching its boiling point ( $290^\circ$ — $300^\circ$ ) with perfectly dry and powdery silver. The tetraiodide was then transformed into a white mass presenting a totally different aspect from its primitive appearance. Upon treating the contents of the vessel with a small quantity of sulphide of carbon, to extract any remains of tetraiodide, and after several washings, dissolving it in a large quantity of hot sulphide of carbon, the product consisted of beautiful colourless crystals, in hexagonal prisms or rhomboidal bases, acting upon polarised light after the manner of doubly refracting substances, and which fume in the air and decompose, forming a white substance. When treated with potash, a lively evolution of hydrogen ensues.

Analysis proves that these crystals are the iodide desired,  $\text{Si}_2\text{I}_6$ , formed by deducting one atom of iodine from the tetraiodide, and re-combining the two residues ( $\text{SiI}_3$ ). The quantity of hydrogen evolved by the action of the potash confirms the result of the analysis, being  $2\text{H}$  in  $\text{Si}_2\text{I}_6$ , which should be, according to the equation—



The hexa-iodide of silicium cannot be distilled either under atmospheric pressure or in a vacuum. It sublimes partially, but decomposes to a great extent into tetra-iodide, leaving an orange-red residue, whose composition corresponds to the formula  $\text{SiI}_2$ , and which is insoluble in sulphide of carbon, benzol, chloroform, and chloride of silicium. This last iodide is changed by water into a white or greyish mass, evolving much hydrogen in the presence of potash. The hexaiodide melts in a vacuum, but with partial decomposition at a temperature of  $250^\circ$ . It is much less soluble than the tetraiodide in sulphide of carbon at  $27^\circ$ ; one part of this liquid dissolves 2.2 parts of  $\text{SiI}_4$  and only 0.26 of  $\text{Si}_2\text{I}_6$ . When crystals of the hexaiodide are thrown into iced water, they decompose without evolution of hydrogen, and the white substance, which remains when dried in a vacuum at  $100^\circ$ , presents a composition corresponding to the formula  $\text{Si}_2\text{O}_4\text{H}_2$ , which is proved by the quantity of hydrogen disengaged by the potash or collected as water, by combustion with oxygen, and by calcining the mass which decomposes with incandescence, and an evolution of hydrogen, leaving a residue of silica, whose weight is almost identical with that of the primitive substance. The iodide of silicium is transformed into a hydrate,  $\text{Si}_2(\text{OH})_6$ , upon contact with water; this hydrate loses  $2\text{H}_2\text{O}$  to form the body,  $\text{Si}_2\text{O}_4\text{H}_2$ , whose composition is analogous to oxalic acid, and which may be called silici-oxalic hydrate.

Salts of this compound could not be obtained. They became decomposed by even the weakest bases, with evolution of hydrogen, as is done by potash under other circumstances in the case of oxalic acid.

Several reactions were tried with the hexaiodide with a view to obtaining a volatile compound without decomposition. After ascertaining that bromine extracts all the iodine from the iodide, and transforms it into a bromide, and that the iodine is capable of reacting on alcoholate of soda, and thus forming an ethereal compound, the action of zinc-ethyl on the hexaiodide was next examined.

Upon mixing the latter with the former in small portions at a time, and gently heating it, a reaction is produced, and a white substance precipitated. When a suitable proportion of iodine ( $\text{Si}_2\text{I}_6$  for  $3\text{ZnEt}$ ) has been added, the reaction is finished; it is then distilled, and the distilled product treated with water to decompose a slight excess of zinc-ethyl. After decanting the water, it is repeatedly washed in concentrated sulphuric acid to remove a substance which is soluble in that liquid, and which appears to be triethyl oxide of silicium. It is then again washed with water, dried, and fractionally distilled; two liquids are thus separated; one, boiling at from  $150^\circ$  to  $154^\circ$ , is siliciumethyl,  $\text{Si}(\text{C}_2\text{H}_5)_4$ ; and the other, which was obtained between  $250^\circ$  and  $253^\circ$ , gives, on analysis, numbers agreeing with the formula  $\text{Si}_2(\text{C}_2\text{H}_5)_6$ . It is a limpid liquid, with a faint smell, resembling that of siliciumethyl and burns with a brilliant flame, giving forth fumes of silica. Upon ascertaining the density of vapour, the figures obtained approached very nearly to those required by the theory for the formula  $\text{Si}_2(\text{C}_2\text{H}_5)_6$ , but somewhat higher (theory 7.96 exp. 8.5). The liquid does not alter sensibly at  $300^\circ$ , but alters slightly, with formation of a product soluble in sulphuric acid, which is doubtless triethyl oxide of silicium,  $\text{Si}_2\text{O}(\text{C}_2\text{H}_5)_6$ , which is formed by oxidation of siliciumhexethyl. The presence of this body explains the slight excess of the found density as compared with the theoretical density. The exactitude of the formula,  $\text{Si}_2(\text{C}_2\text{H}_5)_6$ , is beyond doubt; consequently the series of compounds here spoken of certainly belong to the ethylic group of silicium. The two atoms of silicium are directly connected, and serve as a link to the atoms of iodine, or of oxygen and hydroxyl, or ethyl, which combine with them to form the molecule. The reaction of the zinc ethyl upon the hexaiodide takes place in an exactly similar manner to that of the same body upon the chloride and the iodide of silicium, and furnishes a compound which may be considered as homologous with



siliciumethyl. The study of the reactions of this body will doubtless be interesting, and will probably show that the analogy is not confined to the formulæ.—*Comptes Rendus*.

## ON THE COMPOSITION OF THE WATER OF THE IRISH SEA.\*

By T. E. THORPE, Ph.D., and Mr. E. H. MORTON.

Thanks to the investigations of Forchhammer, Von Bibra, Bischof, and others, our knowledge concerning the nature and distribution of the saline constituents of sea-water and of the causes of the variations in its composition as observed in various parts of the world, is tolerably extensive and precise. English chemists, however, have contributed next to nothing to the general stock of our information on this subject. This is not a little remarkable, especially when we consider the peculiarly favourable condition in which this country is placed for researches of this kind, by reason of its insular position. A few observations by John Davy made in the course of his long voyages, two memoirs by Marcet in the "Philosophical Transactions" for 1819 and 1822 on the temperature and saltiness of various seas, and an elaborate analysis by Schweitzer of the water of the English Channel made in 1838, constitute by far the chief portion of the work done in this direction by English chemists. The chemical history of the sea is mainly to be derived from the researches and observations of chemists principally French and German, the majority of whom were located at considerable distances from the sea-board, and who laboured therefore under all the disadvantages which this circumstance necessarily entails. So far as we can learn the water of the Irish Channel has never been analysed. We have been induced, therefore, to undertake its analysis in the hope of supplying information respecting the nature and extent of the modifications effected in the composition of the sea by its proximity to our coasts. Accordingly Captain Temple of the "Bahama Bank" Light Ship kindly collected for us a quantity of the water in the immediate neighbourhood of his vessel. The vessel is situated in lat.  $54^{\circ} 21' N.$  and long.  $4^{\circ} 11' W.$ , seven miles W.N.W. of Ramsey, Isle of Man, and is placed nearly equi-distant from the shores of England, Scotland, and Ireland. During the greater part of the day a strong current setting in from the south, probably from the Atlantic, flows past the ship into the North Channel, and thence again into the Ocean. The water, therefore, taken for analysis, was originally that of the deep ocean, which had traversed almost the entire length of the Irish Channel, and had consequently been exposed to all the influences due to the neighbouring sea-board, and to the influx of the numerous rivers along the coasts.

The water was obtained in the early part of January, 1870; the meteorological conditions at the time of collection, and for some time previously, were in no wise remarkable. The analysis was commenced immediately on receipt of the water. Its specific gravity compared with distilled water, free from air, and possessing the same temperature, was found to be—

At  $0^{\circ} C.$  .. .. . 1.02721  
At  $15^{\circ} C.$  .. .. . 1.02484

These numbers differ but slightly from that usually accepted as representing the mean specific gravity of the water of the ocean. The water of the Atlantic, according to Von Horner, possesses the specific gravity 1.02875 at  $0^{\circ} C.$ ; that of the English Channel at  $15.5^{\circ}$  was found by Schweitzer to be 1.0271: on nearing the land the specific gravity fell to 1.0268.

\* Read before the Manchester Literary and Philosophical Society, March 22, 1870.

Full details of the methods of analysis employed are given in the original paper. The following synopsis shows the mean results of the determinations: the numbers express the amount of the various ingredients in 1000 grms. of the sea-water.

1 Chlorine .. .. .	18.62650
2 Bromine .. .. .	0.06133
3 Sulphuric acid ( $SO_4$ ) ..	2.59280
4 Lime (total) .. .. .	0.57512
5 Calcium carbonate .. ..	0.04754
6 Magnesia .. .. .	2.03233
7 Mixed alkaline chlorides..	27.18363
8 Potassium.. .. .	0.39131
9 Sodium .. .. .	10.40200
10 Ferric oxide .. .. .	0.00465
11 Ammonia.. .. .	0.00011
12 Nitric acid .. .. .	0.00156
13 Fixed constituents .. ..	33.83855

These substances arranged on the assumption that the strongest acid is united with the strongest base, yield the following numbers:—

Sodium chloride .. .. .	26.43918
Potassium chloride .. ..	0.74619
Magnesium chloride .. ..	3.15083
Magnesium bromide .. ..	0.07052
Magnesium sulphate .. ..	2.06608
Magnesium carbonate .. ..	traces
Calcium sulphate .. .. .	1.33158
Calcium carbonate .. .. .	0.04754
Lithium chloride .. .. .	traces
Ammonium chloride .. ..	0.00044
Magnesium nitrate .. ..	0.00207
Silicic acid .. .. .	traces
Ferrous carbonate .. .. .	0.00503

33.85946

Amount directly determined .. .. 33.83855

The water employed in the foregoing analysis was collected in midwinter. It becomes interesting to know if its composition is uniform during the various seasons of the year. Fortunately we can offer some evidence on this point. In August, 1865, after a continuance of exceptionally fine weather, one of us collected some sea-water in the neighbourhood of the "Bahama Bank" Light Ship, and determined the total quantity of its saline constituents, together with the amount of chlorine and sulphuric acid. The proportion of solid matter contained in the water of the Irish Sea is somewhat greater in summer than in winter—the variation amounting to 0.0144 per cent—but the relative amount of solid matter present in the water of the Irish Channel is invariably less than is contained in the water of the Atlantic Ocean lying between the same parallels.

According to Forchhammer, the mean proportion of the leading constituents of the water of the Atlantic far away from the shores is as follows:—

	Cl.	$SO_3$ .	CaO.	MgO.	Total Salts.
Absolute amount in 1000 grms. .. ..	19.865	2.362	0.588	2.199	35.976
Relative amount ..	100	11.89	296	11.07	181.10

Arranged in this manner, our determinations on the water of the Irish Sea give the following proportions:—

	Cl.	$SO_3$ .	CaO.	MgO.	Total Salts.
Absolute amount per 1000 grms. { Summer..	18.735	2.187	—	—	34.082
{ Winter ..	18.627	2.161	0.575	2.032	33.838
Relative amount. { Summer..	100	11.67	—	—	181.91
{ Winter ..	100	11.63	3.09	10.93	182.09



RESEARCHES ON VANADIUM.\*

PART III. PRELIMINARY NOTICE.

By HENRY E. ROSCOE, B.A., F.R.S.

I. METALLIC VANADIUM.

IN the second part of "Researches on Vanadium," it was stated that the metal absorbs hydrogen. This conclusion has been fully borne out by subsequent experiment: and it appears that the amount of absorbed or combined nitrogen taken up by the metal varies according to the state of division—first, of the chloride ( $VCl_2$ ) from which the metal is prepared, and secondly, and especially, of the metal itself. The metal containing absorbed hydrogen slowly takes up oxygen on exposure to the air, water being formed and the metal undergoing oxidation to the lowest oxide,  $V_2O$ . At this point the oxidation stops.

The difficulty of obtaining metallic vanadium free from admixture of oxide has been again rendered evident. Perfectly pure tetrachloride was prepared in quantity, and from this pure dichloride was made. On heating this to whiteness for forty-eight hours, a substance was obtained which gained, on oxidation, 70.7 per cent (vanadium requiring 77.79 percentage increase), and, therefore, still contained a slight admixture of oxide.

The reducing action of sodium on the solid chlorides was next examined; in this case, the reduction takes place quietly in an atmosphere of hydrogen at a red heat, and is best conducted in strong iron tubes. Explosions occur when sodium acts on the liquid tetrachloride. The substance thus obtained was found, after lixiviation, to be free from chlorine, and on washing it separated into two portions—(1) a light and finely-divided black powder (trioxide), which remains in suspension, and is soluble in hydrochloric acid; and (2) a heavier grey powder, insoluble in hydrochloric acid, which soon deposits, and can, by repeated washing, be completely freed from the lighter trioxide. This bright grey powder consists of metallic vanadium, mixed with more or less oxide. If this metallic powder, after drying *in vacuo*, be reduced at a low red heat in a current of pure hydrogen, the powder, even when cold, on exposure to air or oxygen, takes fire spontaneously, water being formed, whilst the vanadium undergoes oxidation, forming the blue oxide,  $V_2O_4$ . A portion of metal exposed for some weeks to the air also slowly absorbed oxygen, passing into the oxide,  $V_2O$ .

II. VANADIUM AND BROMINE.

1. *Vanadium Tribromide*,  $VBr_3$ ; molec. wt. = 291.3.—When excess of bromine is passed over vanadium mononitride heated to redness, a vivid action occurs, and dense dark-brown vapours are formed, condensing in the cooler portions of the tube to a greyish black, opaque, amorphous mass of the tribromide. The tribromide is a very unstable compound, losing bromine even when kept sealed up in glass tubes; it is very deliquescent, and, on heating in the air, rapidly loses all its bromine and takes up oxygen, with formation of vanadic acid. On being thrown into water, the tribromide readily dissolves, forming a brown liquid (in this respect resembling the trichloride), which, on addition of a few drops of hydrochloric acid, turns of a bright green colour, showing the presence of a solution of an hypovanadic salt. No free bromine or hydrobromic acid is given off on dissolving the tribromide in water. That a more volatile higher bromide was not formed in this reaction was shown, inasmuch as, on distilling the excess of liquid which had collected in the receiver, it was found to consist of free bromine, containing mere traces of the tribromide mechanically carried over. The tribromide is likewise formed when bromine is passed over a red-hot mixture of vanadium, trioxide, and pure charcoal, as in the preparation of the tetrachloride; but this method is not one to be recommended,

as the tube becomes constantly stopped up by the formation of the solid tribromide.

The analysis of the tribromide was made by dissolving the compound in water, and precipitating the bromine with excess of nitrate of silver, the vanadium being estimated as  $V_2O_5$ , either in the filtrate from the bromide of silver or in a separate portion. The bromine in the above determinations, obtained by precipitation as silver-salt, was invariably found to be too high, whilst the vanadium nearly agreed with the theoretical percentage. This is due to the fact pointed out by Stas, in his "Recherches" (p. 156), that bromide of silver, when boiled, encloses, mechanically, a portion of the precipitant, which then cannot be washed out. The loss of weight obtained by reducing the bromide to metallic silver in a current of hydrogen, taken as bromine, gave more nearly agreeing numbers:—

		Calculated.	Mean of 6 determinations.
Vanadium	.. $V = 51.3$	17.61	18.44
Bromine	.. $Br_3 = 240.0$	82.39	80.86
	291.3	100.00	99.30

2. *Vanadium Oxytribromide*, or *Vanadyl Tribromide*,  $VOBr_3$ , molec. wt. = 307.3.—The oxytribromide is a dark-red transparent liquid, evolving white fumes on contact with the air, obtained by passing pure and dry bromine over vanadium trioxide ( $V_2O_3$ ) heated to redness. Moisture prevents the formation of the oxytribromide; and it not only undergoes sudden decomposition when heated to  $180^\circ$ , but also slowly decomposes at the ordinary atmospheric temperatures. The boiling-point of the tribromide can, however, be brought below the temperature of decomposition by distillation *in vacuo*, and the liquid can then be freed completely from bromine by passing a current of dry air through the liquid. Under a pressure of 100 m.m., the oxytribromide boils from  $130^\circ$  to  $135^\circ$ , and may be distilled almost without decomposition. Vanadium oxytribromide dissolves in water, yielding a yellow-coloured solution, in which both vanadium and bromine were determined, after reduction with sulphurous acid—

		Calculated.	Mean of several analyses.
V	.. .. = 51.3	16.69	16.75
$Br_3$	.. .. = 240.0	78.10	79.20
O	.. .. = 16.0	5.21	—
		100.00	

The sp. gr. of the oxytribromide, at  $0^\circ$ , is 2.967.

3. *Vanadium Oxydibromide*, or *Vanadyl Dibromide*,  $VOBr_2$ , molec. wt. = 227.3.—This is a solid substance, of a yellowish brown colour, obtained by the sudden decomposition of the foregoing compound at temperatures above  $100^\circ$ , or by its slow decomposition at the ordinary temperature.

The oxydibromide is very deliquescent, dissolving in water, with formation of a blue solution of a vanadious salt. When heated in the air, it loses all its bromine, and is converted into  $V_2O_5$ .

Analysis gave—

		Calculated.	Mean of several analyses.
V	.. .. = 51.3	22.570	22.45
$Br_2$	.. .. = 160.0	70.390	70.93
O	.. .. = 16.0	7.104	—
	227.3	100.000	

III. VANADIUM AND IODINE.

Iodine vapour does not attack either the trioxide or the nitride at a red heat; both these substances remain unchanged, and no trace of vanadium can be detected in the iodine which has passed over them.

\* Read before the Royal Society, April, 1870.



## IV. THE METALLIC VANADATES.

In the first part of these Researches (*Phil. Trans.* 1868), it was pointed out (1) that the salts analysed by Berzelius must be considered as meta- or mono-basic vanadates, (2) that the so-called bivanadates analysed by Von Hauer are anhydro-salts, and (3) that the ortho- or tribasic vanadates contain 3 atoms of monad metal, the sodium salt being formed artificially by fusing 1 molecule of vanadium pentoxide with 3 molecules of carbonate of soda, when 3 molecules of carbon dioxide are expelled, whilst the orthosalts occur native in many minerals. The present communication contains a description of these classes of salts, as well as of a new class of salts, the tetrabasic or pyro-vanadates.

## Sodium Vanadates.

1. *Ortho- or Tri-Sodium Vanadate*,  $\text{Na}_3\text{VO}_4 + 16\text{H}_2\text{O}$ .—When a mixture of 3 molecules of  $\text{Na}_2\text{CO}_3$  and 1 molecule of  $\text{V}_2\text{O}_5$  is fused until no further evolution of  $\text{CO}_2$  is observed, a tribasic vanadate remains as a white crystalline mass. This mass dissolves easily in water, and on addition of absolute alcohol to the solution two layers of liquid are formed; the lower one solidifies after a time, forming an aggregation of needle-shaped crystals, which possess a strongly alkaline reaction. These having been washed with alcohol, and dried on a porous plate over sulphuric acid *in vacuo*, were analysed with the following results:—

	Calculated.	Found.
$\text{Na}_3 \dots = 69.0$	14.60	13.80
$\text{V} \dots = 51.3$	10.86	10.86
$\text{O}_4 \dots = 64.0$	13.56	—
$16\text{H}_2\text{O} \dots = 288.0$	60.97	60.44
	<hr/> 472.3	<hr/> 99.99

The sodium in this and in the following compounds was separated from the vanadium by precipitating the vanadic acid as the perfectly insoluble basic lead salt hereafter described. This was dried at  $100^\circ$  and weighed, then dissolved in nitric acid and decomposed by sulphuric acid, and the solution of  $\text{V}_2\text{O}_5$  in excess of this acid gave, on evaporation, a finely crystalline mass. The filtrate from the lead precipitate freed from lead yielded on evaporation sodium sulphate. Full analytical details of this method, as well as of the other by precipitation, as the insoluble ammonium metavanadate, are given in the memoir. By frequent crystallisations the tri-sodium vanadate is slowly decomposed into the tetrasodium salt, caustic soda being formed. This singular reaction was most carefully examined and the amount of sodium hydroxide liberated determined diametrically.

2. *Tetrasodium Vanadate*,  $\text{Na}_4\text{V}_2\text{O}_7 \cdot 18\text{H}_2\text{O}$ .—This salt crystallises in beautiful six-sided tables. It is easily soluble in water, insoluble in alcohol, and is precipitated by the latter liquid from aqueous solution in white scales of a silky lustre. As long as the salt contains free alkali or tribasic salt, it forms, on precipitation with alcohol, oily drops which solidify after some time. The tetrasodium vanadate is always formed by the first fusion of vanadic acid with excess of carbonate of soda, and can be easily prepared in the pure state by re-crystallisation.

	Calculated.	Found (mean of several determinations).
$\text{Na}_4 \dots = 92.0$	14.58	14.61
$\text{V}_2 \dots = 102.6$	16.27	15.97
$\text{O}_7 \dots = 112.0$	17.27	—
$18\text{H}_2\text{O} \dots = 324.0$	51.38	51.80
	<hr/> 630.6	<hr/> 99.99

The salt loses 17 molecules of water at  $100^\circ$ .

The corresponding Calcium and Barium Vanadates,  $\text{Ca}_2\text{V}_2\text{O}_7$ , and  $\text{Ba}_2\text{V}_2\text{O}_7$ , are white precipitates obtained by adding the chlorides to a solution of tetrasodium vanadate. If calcium chloride be added to a solution of the trisodium salt,

dicalcium vanadate is precipitated, the solution becoming strongly alkaline from formation of calcium hydroxide and absorbing carbonic acid from the air. Complete analysis showed that the calcium salt contains  $2\frac{1}{2}$  molecules of water of crystallisation, whilst the barium salt is anhydrous.

## Lead Vanadates.

1. *Tribasic or Ortho-Lead Vanadate*,  $\text{Pb}_3(\text{VO}_4)$ .—Obtained as a light yellow insoluble powder on precipitating the tribasic sodium salt with a soluble lead salt; it yielded on analysis 11.75 per cent of vanadium, the calculated quantity being 12.04 per cent.

2. *Vanadinite, the Double Ortho-vanadate and Chloride of Lead*,  $3\text{Pb}_3\text{VO}_4 + \text{PbCl}_2$ , can be artificially prepared by fusing for a few hours a mixture of vanadic acid, oxide of lead, and chloride of lead, in the above proportions, together with an excess of sodium chloride. After cooling, a greyish crystalline mass is left, containing cavities filled with long crystals having the same colour as the mass, which under the microscope could be distinguished as six-sided prisms. The crystalline powder is then boiled with water until no further traces of soluble chlorides are extracted.

The following analysis shows that this substance has the same composition as the vanadinites from Zimapan and Windischkappel, analysed by Berzelius and Rammelsberg.\*

	Calculated. $3(\text{Pb}_3\text{VO}_4) + \text{PbCl}_2$ .	Natural vanadinite.		
		Zimapan, Berzelius.	Windischkappel, Rammelsberg.	Artificial vanadinite.
Lead .. ..	73.08	70.40	71.20	71.96
Vanadium ..	10.86	—	9.77	11.11
Chlorine ..	2.50	2.54	2.23	2.31
Oxygen ..	13.55	—	—	—

The specific gravity of the artificial vanadinite at  $12^\circ \text{C}$ . is 6.707, that of the natural being 6.886.

3. *Basic Di-Lead Vanadate*,  $2(\text{Pb}_2\text{V}_2\text{O}_7) + \text{PbO}$ .—Acetate of this salt is precipitated as a pale yellow powder when lead is added to a solution of disodium vanadate, the liquid acquiring an acid reaction. It is completely insoluble in water and in dilute acetic acid, but dissolves readily in nitric acid.

	Calculated.	Mean found.
$\text{Pb}_5 \dots = 1035.0$	69.92	70.18
$\text{V}_4 \dots = 205.2$	13.86	13.30
$\text{O}_{15} \dots = 240.0$	16.22	—
	<hr/> 1480.2	

## Silver Vanadates.

1. *The Ortho-silver Vanadate*,  $\text{Ag}_3\text{VO}_4$ , is obtained as an orange-coloured precipitate by mixing a freshly prepared solution of the trisodium salt with a solution of silver nitrate, in which every trace of free acid has been neutralised; unless these precautions are attended to, the precipitate consists of a mixture of the ortho- and pyro-salt. The tri-silver vanadate is insoluble in water, but readily dissolves in ammonia and nitric acid. Analysis gave the following results:—

	Calculated.	Found (mean).
$\text{Ag}_3 \dots = 324.0$	73.75	73.83
$\text{V} \dots = 51.3$	11.67	11.76
$\text{O}_4 \dots = 64.0$	14.58	—
	<hr/> 439.3	<hr/> 100.00

2. *The Tetrabasic Silver Vanadate*,  $\text{Ag}_4\text{P}_2\text{O}_7$ , is prepared by mixing a solution of the corresponding sodium salt with a neutral solution of nitrate of silver. It falls as a yellow dense crystalline precipitate, resembling in colour the ordinary phosphate of silver. On dissolving the salt in nitric acid, the silver is precipitated as chloride, and the vanadium determined as  $\text{V}_2\text{O}_5$ .

\* Pyromorphite and apatite have already been artificially prepared by Deville and Caron, and also by Debray, whilst mimetite has been obtained artificially by Lechartier.



Analysis gave :—

			Calculated.	Found.
Ag <sub>4</sub>	.. ..	= 432.0	66.81	66.45
V <sub>2</sub>	.. ..	= 102.6	15.87	15.97
O <sub>7</sub>	.. ..	= 112.0	17.32	—
		646.6	100.00	

I have to thank Messrs. Œlhofer and Finkelstein for the valuable assistance which they have given me in the above investigation.

## PROCEEDINGS OF SOCIETIES.

### ROYAL INSTITUTION OF GREAT BRITAIN.

Friday, April 1st, 1870.

"On the Artificial Production of Alizarine, the Colouring Substance of Madder," by Prof. H. E. Roscoe, F.R.S., Owen's College, Manchester.

The speaker stated that he had to bring before the notice of his audience a discovery in organic chemistry which, whether we regard its scientific interest or its practical and commercial value, is of the highest importance, and marks an era in the history of the application of chemistry to the arts and manufactures even of greater importance than the memorable discovery made by Mr. Perkin in 1856 of the production of aniline-violet, or mauve.

Since the above-named year great progress has been made in the theoretical investigation of natural and artificial colouring matters, as well as in their preparation on a large scale. The chemistry of colouring matters has now taken a high and important position, and chemists instead, as formerly was their wont, of getting rid of all colouring matters as something foreign to their objects of investigation, have, since Mr. Perkin's discovery, found out that the examination of colouring matters may not only lead to scientific laurels, but may sometimes yield fruit of another and not less acceptable kind.

We owe to the brains and hands of two German chemists, Messrs. Graebe and Liebermann, this remarkable discovery, which differs from all the former results which have been brought about by the application of science to the chemistry of colouring matters, inasmuch as this has reference to the artificial production of a natural vegetable colouring substance which has been used as a dye from time immemorial, and is still employed in enormous quantities for the production of the pink, purple, and black colours which are seen everywhere on printed calicoes, viz. alizarine, the colouring principle of madder.

It is from the liquid tarry products of the destructive distillation of coal, a rich source of interest to chemists, that we now derive this new colouring matter.

The following table contains the results of experiments made on the large scale, indicating the various yields of tar from different qualities of coal distilled in the gas-works of various towns :—

#### DESTRUCTIVE DISTILLATION OF COAL.

100 tons of cannel and bituminous coal distilled to yield 10,000 cubic feet of gas of sp. gr. 0.6, yield the following products :—

	Gas.	Tar.	Ammonia Water.	Coke.	
1	22.25	8.50	9.50	59.75	Average of many experiments.
2	20.01	7.85	7.14	65.00	Manchester.
3	20.40	6.40	5.40	67.85	Dukinfield.
4	21.70	7.50	5.80	65.00	Macclesfield.
5	16.30	10.70	8.00	65.00	Salford.

From a careful series of experiments made by a large tar distiller, the following numbers are derived, showing the average composition of gas tar :—

100 tons of tar on distillation yield :—

	Naphtha.	Light Oils and Carbolic Acid.	Heavy Oils, Naphthalene, Anthracene.	Pitch.	Water, Gas, and Loss.
1.	3.0	1.5	35.0	50.0	10.5
2.	3.0	0.8	25.0	60.0	12.2

It is from benzol, C<sub>6</sub>H<sub>6</sub>, discovered by Faraday in 1825, that the aniline colours are all of them prepared. The colour-producing power of the coal products are, however, yet far from being exhausted. It is by means of another, and hitherto comparatively unknown, hydrocarbon, anthracene, C<sub>14</sub>H<sub>10</sub>, that the newest triumphs of the chemist have been won. This is a substance which in the pure state few chemists (even yet) have seen, and upon which only two or three had previously experimented, and yet by one happy discovery—and by an investigation which more than almost any other exhibits the value of the synthetic power of modern research—this unknown body has been made to yield a colouring matter of the greatest possible value. The truth of this will at once be evident when we learn that the total growth of madder is estimated to reach 47,500 tons per annum, worth £45 per ton, and having, therefore, a value of £2,150,000. Of this nearly one-half is used in the United Kingdom, so that no less a sum than £1,000,000 is now paid by us for madder grown in foreign countries. This will now, in part at least, go to benefit our own population, as we can now transform our coal into this invaluable colouring matter.

In an experiment made on a large scale it was found that 100 tons of tar yielded 0.63 ton of anthracene, or 1 ton of anthracene can be obtained from the distillation of about 2000 tons of coal, not reckoning the quantity of anthracene contained in the pitch.

Madder is the root of several species of Rubia, amongst which the *Rubia tinctorum* is the most valued for its dyeing properties. This grows in Holland, Asia Minor, and in the south of France and of Russia. A species native to England is the *Rubia peregrina*. This belongs to the order Rubiaceæ, the native members of which, as the Galiums, are mostly inconspicuous wild plants. Some of the foreign species are, on the contrary, important plants, such as the cinchona, ipecacuanha, and coffee plants, and these are distinguished for the number and variety of the peculiar principles which they yield, as quinine, cinchonine, caffeine, alizarine. Thanks to the kindness of Dr. Schunck, the speaker was able to show a young madder plant.

In spite of the many investigations which have been made of madder, chemists are still in doubt as to the nature of many of its constituents. Some attribute its colouring powers to the presence of at least two substances—alizarine and purpurine—while others say that only one of these produces the true madder colours.

Alizarine was discovered and obtained from madder, as a crystalline sublimate, by Robiquet and Colin, in 1831, but little importance attached to this discovery until Schunck, in 1848, showed that all the finest madder colours contain only alizarine combined with bases and fatty acids. The second colouring matter, termed purpurine, was discovered by Persoz. It contributes to the full and fiery red colour in ordinary madder dyeing, but dyes a bad purple, alizarine being essential to the latter. Purpurine disappears during the purifying processes of soaping, &c., being far less stable than alizarine. It is distinguished from alizarine by its solubility in boiling alum liquor.

These two colouring principles may likewise be easily distinguished by the spectrum, alizarine producing a set of dark absorption bands, quite different from those of purpurine, which again vary according to the nature of the solvent. Alizarine can be obtained in yellow needle-



shaped crystals by simple sublimation from the dried madder; but this colouring matter is, singularly enough, not contained ready formed in the fresh madder root, but is the product of a peculiar decomposition. For a proof that fresh madder does not contain alizarine we have only to extract the moist root with alcohol, when neither the alcoholic extract nor the insoluble residue will be found to possess tinctorial power. We owe this knowledge to the researches of Schunck and Higgin, who have proved that alizarine is produced by a peculiar kind of fermentation, which partly occurs in the root on standing, and and partly takes place in the dyebeck, when the powdered madder is treated with water. A crystalline glucoside, termed rubianic acid (Schunck), is contained in the root, and it is this which splits up simply into alizarine glucose. This acid crystallises in fine yellow needles, and gives a definite and crystalline potash salt, from which it was shown to contain 26 atoms of carbon in the molecule. Hence, as no other product but glucose is formed, it follows that alizarine must contain  $C_{26} - C_{12} = C_{14}$ . This decomposition of rubianic acid into alizarine was shown by boiling with an acid, and adding caustic soda when the blue solution of alkaline alizarine was seen. The formation of alizarine in extracts of madder root is effected by a ferment peculiar to the plant, and called erythrozym. It is a ferment *sui generis*, since no other ferment produces the same effect. When mixed with a solution of rubian or rubianic acid, at the ordinary temperature, the latter is rapidly decomposed as with acids. This is what takes place in making *fleur de garance*. Dyers raise the temperature of their madder-baths gradually up to the boiling point, because the application of a high temperature destroys the ferment. When the temperature is gradually raised, the ferment acts upon the glucoside, and produces alizarine.

That the colouring matter in fresh madder root is not alizarine can be easily shown by rubbing the soft portions of the root on to paper, when a yellow stain will be produced, which, on treatment with an alkali, shows the bright red colour of an alkaline solution of rubian instead of the blue solution of alizarate.

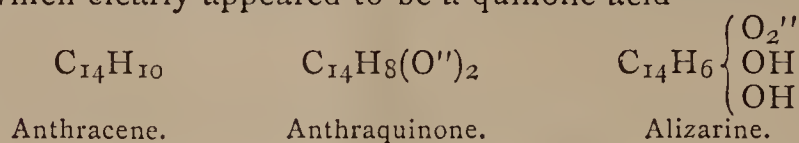
According to Schunck, the origin of purpurine, and its relation to alizarine, are still involved in obscurity.

The hypothesis which of late years has done more than any other to stimulate experiment and enlarge our views in organic chemistry is undoubtedly Kekulé's theory of the tetrad nature of carbon and his explanation of the constitution of the carbon compounds. In the so-called paraffine group of organic substances, the carbon atoms are supposed to be connected together by single links of the four bonds attached to each atom, thus giving rise to saturated compounds by the attachment of other elements or radicals to the free bonds. In the group of aromatic substances with which we are specially concerned the carbon atoms are more closely linked together, or, in other words, a less number of atoms of hydrogen are necessary to saturate an aggregation of carbon atoms than is the case in the other group. We can explain this, upon the assumption of the tetrad character of carbon, by supposing that each carbon atom is attached to its neighbour alternately by one and by two bonds.

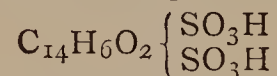
Another singular property of these aromatic bodies is that they all contain at least six atoms of carbon, and that the simplest hydrocarbon of which they are made up is benzol,  $C_6H_6$ . So that we may regard all these aromatic compounds as benzol derivatives, and this hydrocarbon may be considered as the skeleton round which many complicated substances are arranged. So that by the replacement of one atom of hydrogen by  $NH_2$ , we obtain aniline, by OH phenol, &c. From the knowledge gained by his investigation on the quinones, Graebe came to the conclusion that alizarine belongs to the quinone series; and, availing themselves of Baeyer's reaction, by which phenol can be converted into its hydrocarbon, benzol, Graebe and Liebermann passed the vapour of natural alizarine obtained from madder over heated

zinc-dust, and found that the hydrocarbon they formed was identical in all its properties with anthracene,  $C_{14}H_{10}$ , from coal tar. Hence they confirmed Schunck's conclusions that the molecule of alizarine contains fourteen atoms of carbon. Having thus got hold of the backbone, as it were, of the compound, it only remained for them to clothe the hydrocarbon with the four additional atoms of oxygen and to take off the two atoms of hydrogen in excess, in order to obtain alizarine.

Laurent and also Anderson had, many years ago, obtained a body of the composition  $C_{14}H_8O_2$ , and Graebe recognised this as the quinone of anthracene; and he now only required to replace in this two atoms of hydrogen by two of hydroxyl (OH), in order to obtain alizarine, which clearly appeared to be a quinone acid—



This replacement of hydroxyl can be effected by bromine, by which bibromanthraquinone  $C_{14}H_6Br_2O_2$  is formed, and this, on fusion with caustic potash, gives potassium alizarate, yielding pure alizarine on treatment with hydrochloric acid. The high price of bromine rendered this process unavailable for manufacturing purposes, and hence another plan was simultaneously proposed by several chemists for effecting the same end in a cheaper mode. Use was hereby made of Kekulé's and Wurtz's reaction in the formation of sulpho-benzolic acid. On treating anthraquinone with strong sulphuric acid to a high temperature, the di-sulpho acid—



is formed, and this on heating with concentrated solution of potash, yields the sulphite and alizarate of potassium; from the latter substance pure alizarine is obtained by the action of acids.

In the following table we have a statement of the synthetic production of alizarine from its constituent elements.

#### SYNTHESIS OF ALIZARINE.

1. Acetylene by direct union of carbon and hydrogen in electric arc.
 
$$C_2 + H_2 = C_2H_2 \quad (\text{Berthelot, 1862.})$$
  2. Benzol (tri-acetylene) from acetylene by heat.
 
$$3C_2H_2 = C_6H_6 \quad (\text{Berthelot, 1866.})$$
  3. Anthracene from benzol and ethylene.
 
$$2C_6H_6 + C_2H_4 = C_{14}H_{10} + 3H_2 \quad (\text{Berthelot, 1866.})$$
  4. Alizarine from anthracene. (Process No. 1.)
 

(Graebe and Liebermann, 1869.)

    - (A) Oxyanthracene or anthraquinone by nitric acid.
 
$$C_{14}H_6(OH)_2 \quad (\text{Anderson, 1861.})$$
    - (B) Bibromanthraquinone by action of bromine.
 
$$C_{14}H_8O_2 + 2Br_2 = C_{14}H_6Br_2O_2 + 2HBr$$
    - (C) Alizarine by action of caustic potash.
 
$$C_{14}H_6Br_2O_2 + 4KHO = C_{14}H_6(OK)_2O_2 + 2KBr + 2H_2O$$

Potassium alizarate.
  5. Alizarine from anthracene. (Process No. 2.)
 

(Graebe and Caro, Perkin, Schorlemmer, and Dale.)

    - (A) Disulphoanthraquinonic acid from anthraquinone.
 
$$C_{14}H_6(OH)_2 + 2H_2SO_4 = C_{14}H_6O_2 \left\{ \begin{array}{l} SO_3H \\ SO_3H \end{array} \right\} + 2H_2O$$
    - (B) Alizarine from the above by the action of potash.
 
$$C_{14}H_6O_2 \left\{ \begin{array}{l} SO_3H \\ SO_3H \end{array} \right\} + 4KHO =$$

$$= C_{14}H_6O_2 \left\{ \begin{array}{l} OH \\ OH \end{array} \right\} + 2K_2SO_3 + 2H_2O$$

Alizarine.
- Mr. Perkin states that an intermediate substance is formed in this reaction having the formula—
- $$C_{14}H_6(O)_2'' \left\{ \begin{array}{l} OK \\ OSO_3 \end{array} \right.$$



and this, when heated with potash, splits up into alizarine and a sulphite. Other yellow-coloured products are, according to Perkin, contained in the alizarine as sent out from his manufactory. The nature of these yellow crystalline bodies is as yet unknown.

Of the identity of the natural with the artificial alizarine there can be no doubt: they agree in all their physical and chemical properties. Their absorption spectra are identical, their tinctorial powers are the same; the coloured lakes which they form with alumina, iron, and copper salts, are of the same tint, and possess the same degree of solubility, and these remain alike unaltered by the action of light, so that when they are fixed in the cotton-fibre they yield equally fast colours.

It is difficult to predict how far the artificial alizarine will in future restrict the growth of madder; but there is no doubt that for many styles of calico-printing the artificial alizarine is of the greatest value, and we may naturally expect to see very important changes effected in this branch of chemical industry in the further practical application of this new discovery.

*Contributions to the History of Alizarine.*  $C_{14}H_8O_4$ .

- 1825. Faraday discovered benzol in coal-gas oil.  $C_6H_6$ .
- 1831. Robiquet and Colin discovered alizarine in madder root.
- 1832. Dumas and Laurent discovered anthracene in in coal oils.
- 1848. Schunck gave the composition of alizarine,  $C_{14}H_{10}O_4$ .
- 1850. Strecker gave the composition of alizarine,  $C_{10}H_6O_3$ .
- 1862. Anderson examined anthracene compounds,  $C_{14}H_{10}$ .
- 1865. Kekulé explained the constitution of the aromatic compounds.
- 1866. Baeyer obtained benzol from phenol.
- 1868. Graebe investigated the quinones.
- 1868. Graebe and Liebermann obtained anthracene from alizarine.
- 1869. Graebe and Liebermann obtained alizarine from anthracene.

## NOTICES OF BOOKS.

*First Report of the Commissioners Appointed in 1868 to Inquire into the Best Means of Preventing the Pollution of Rivers. (Mersey and Ribble Basins.)* Vol. i. 1870.\*

(Continued from p. 176.)

TURNING our attention now to the remedies proposed, we find the following in respect of the purification of sewage, treated under the three heads of—Treatment with Chemicals; Filtration; and Irrigation. The first of these is alluded to as follows:—

“*Purification of Sewage by Chemical Agents.*—The valuable constituents of sewage present to the chemist a mine of wealth, which, despite so many failures, has constantly stimulated him to renewed efforts for their extraction in a portable, and consequently marketable, form.

“The chief valuable ingredients of sewage are, first, the different forms of combined nitrogen; and, second, phosphoric acid. The money-value of these constituents dissolved in 100 tons of average sewage is about 15s., whilst the *suspended matters* contain only about 2s. worth of them.

“There is but little difficulty in extracting the suspended matters by filtration, but, as these do not contain quite one-seventh of the total valuable constituents, the process, though simple, has never been remunerative; and, inasmuch as it still leaves much putrescible organic matter in solution, the mere extraction of the suspended matters of

sewage, although doubtless tending to mitigate nuisance, does not produce any substantial diminution of the polluting quality of the liquid. The operations of the chemist have therefore been directed chiefly to the soluble constituents of sewage; and have had for their object, either the precipitation in a solid form of the valuable, but offensive, ingredients, so as to convert them into portable manure, or, secondly, the rendering them inoffensive by the action of disinfectants. Although these operations have not been altogether unsuccessful, they have hitherto entirely failed in purifying average sewage to such an extent as to render it admissible into running water. We have formed this opinion both from observations of the polluting effect of such chemically-purified sewage upon the streams into which it was admitted, and from the amount of putrescible organic matter revealed by the chemical analysis of the sewage after treatment.

“The following is a description of those processes belonging to the chemical category which we have witnessed in operation:—

“(a). *Treatment with Lime.*—This process was doubtless first suggested by the ingenious operation devised by the late Dr. Clarke, of Aberdeen, for softening certain hard waters. It has been applied to sewage upon an extensive scale, at Tottenham, for the manufacture of “Tottenham sewage guano;” at Blackburn, and especially at Leicester, in the production of the so-called “Leicester bricks” (the name under which the manure was sold). In all these places, the plan has been a conspicuous failure, whether as regards the manufacture of valuable manure, or the purification of the offensive liquid.

“We have witnessed the process at Blackburn, and on two occasions at Leicester, where it is still used, the machinery employed at the latter place being very perfect and efficient.

“At both places the method obviously failed in the purification of the sewage to such an extent as to render it admissible into a river. At Blackburn especially the river below the outlet of the limed sewage was in a most offensive condition of putrefaction, our note made at the time of our visit being as follows:—‘Horribly offensive, turbid, blackish stream, disengaging most offensive gases, with black masses of putrid mud floating on the surface.’

“The operation is exceedingly simple, and, as carried out at Leicester, consists in mixing with the sewage, as it arrives at the works, a certain proportion of milk of lime. The mixture is then violently agitated by appropriate machinery on its way to large reservoirs of subsidence, in which a copious deposit of highly-putrescible mud takes place, whilst the supernatant liquid flows off in a comparatively clear, though still somewhat milky, condition. The floors of the reservoirs of subsidence slope from two opposite sides towards the centre, where there is a gutter, from which a Jacob’s-ladder elevates the slush into a shoot, through which it is conveyed to pits, where it slowly dries, partly by evaporation and partly by soakage into the surrounding soil.

“(b). *Treatment by Sillar’s Patent or “A.B.C.” Process.*—The specification of this process is given by the patentees, Messrs. W. C. and R. G. Sillar and W. G. Wigner, as follows:—

“‘We add to the sewage to be purified a mixture consisting of the following ingredients:—Alum; blood; clay; magnesia or one of its compounds (by preference the carbonate or the sulphate); manganate of potash or other compound of manganese; burnt clay, otherwise known as ballast; chloride of sodium; animal charcoal; vegetable charcoal; and magnesian limestone. Of these substances, the manganese compound, the burnt clay, chloride of sodium, and magnesian limestone, may be omitted; and it is not essential that both animal and vegetable charcoal should be used. If any of the ingredients named should from any cause be present in sufficient quantity in the sewage, it may of course be omitted from the mixture. The proportions in which the ingredients are to be used



vary according to the nature of the sewage to be purified—as, for instance, if a large proportion of urine is present, we increase the proportion of clay; if the sewage is much diluted, we slightly increase the proportion of alum and blood; if it contains a large proportion of street-refuse, we decrease the proportion of clay.

“For ordinary sewage, the following proportions have answered well:—

Alum .. .. .	600 parts
Blood .. .. .	1 ”
Clay .. .. .	1900 ”
Magnesia .. .. .	5 ”
Manganate of potash ..	10 ”
Burnt clay .. .. .	25 ”
Chloride of sodium ..	10 ”
Animal charcoal .. ..	15 ”
Vegetable charcoal ..	20 ”
Magnesian limestone ..	2 ”

“These substances are mixed together, and added to the sewage to be purified until a further addition produces no further precipitate. The quantity required will be about 4 lbs. of the mixture to 1000 gallons of sewage. In many cases, it is preferable to mix the above compound with a small quantity of water, and add it in a liquid state to the sewage. The sewage must then be thoroughly mixed with the compound, and allowed to flow into settling-tanks. The greater part of the organic and other impurities will be immediately separated in the form of large flakes, which rapidly fall to the bottom, leaving the supernatant water clear and inodorous, or nearly so. The water may then be allowed to flow away into a river, or be disposed of in any other way, and the sediment or mud allowed to accumulate at the bottom of the tank. In some cases, it is preferable to add the compound of manganese to the water after the sediment produced by the other ingredients has been allowed to subside. The sediment will be found to possess the power of precipitating a further quantity of sewage; it must therefore be pumped or otherwise taken from the tank, and mixed with fresh sewage, the sediment being allowed to subside in the same way as before. The sediment may be used five or six times over in this way. When the sediment no longer possesses the power of precipitating the impurities in the sewage, it must be removed from the tank, and allowed to dry. When partially dry, a small quantity of acid (by preference sulphuric acid) may be mixed with it, which will retain all the ammonia in a soluble form. When dried, the sediment will be a valuable manure.”

Speaking of this process the Commissioners say that, “Notwithstanding the loss of nitrogenous organic matter in the process of deodorisation, the ‘A.B.C.’ method of treatment still yields a solid manure of much greater value than that obtained by the lime process—a circumstance which is explained, to a great extent, by the acidity of the mud from the former process, and the alkalinity of that from the latter. The lime mud thus loses ammonia in drying, whilst the other, especially if still further acidified, cannot suffer this loss.”

The analysis of the mud shows that “In the three valuable constituents of manure, viz., in ammonia, in other forms of combined nitrogen, and in phosphoric acid, the manure obtained by Sillar’s process is greatly superior to that resulting from the treatment with lime. Unfortunately, some doubt is thrown upon the source of the increased amount of phosphoric acid present in the manure obtained by the former process, because bone-black, in, to us, unknown quantity, entered into the composition of the precipitating material used, and thus an uncertain amount of phosphoric acid was added to that which was actually derived from the sewage.”

The results of their experiments on the Sillar and lime processes are summarised as follows:—

“1. The ‘Sillar’ and lime processes remove to a great and nearly equal extent the suspended matters contained in sewage.

“2. Sillar’s process increases the amount of dissolved solid matters in sewage, but reduces the quantity of putrescible organic matter. The lime process reduces both the amount of dissolved solid substances and the quantity of putrescible organic matter; the reduction of the last being about the same as that effected by Sillar’s process, viz., rather more than one-half.

“3. Both processes fail in purifying sewage to such an extent as to render it admissible into running water.”

“4. For the manufacture of solid manure from sewage, Sillar’s process is greatly superior to the method of treatment by lime, although it fails to extract from the liquid more than a very small fraction of its valuable constituents.”

The treatment by lime and chloride of iron is described as follows:—

“At Northampton, this process is applied to the sewage of 40,000 people. 4400 houses are here connected with the drains, and 2800 are undrained. The excellent and constant water supply of 600,000 gallons daily, or 15 gallons per head, is derived chiefly from deep wells in the oolite. The sewage works are situated about half a mile from the town. Each million gallons of sewage is here mixed with 12 bushels of lime and about 6 gallons of chloride of iron (in hot weather more; in cold weather less). The lime is added first, and then the chloride of iron. The defecated sewage is afterwards submitted to upward filtration through a stratum of calcined iron-ore 8 inches thick; but we consider that, beyond the separation of suspended matters, which would be equally effected by subsidence, this latter operation is nearly useless. The effluent sewage, after a flow of  $1\frac{1}{2}$  miles through a culvert, in which it becomes mixed with about one-sixth of its volume of spring water, is discharged into the river Nen, in a nearly clear and apparently innocuous condition. We examined the stream for about one-third of a mile below the outfall, and could perceive no sewer-fungus or other sign of sewage pollution. Nevertheless, analysis shows that the sewage discharged into the stream still contains in solution a large amount of putrescible organic matter; but the putrescence of this matter was doubtless delayed, by the chloride of iron used in the treatment, until the stream had flowed beyond the point where we examined it. It is well known that chloride of iron possesses this property in a very remarkable degree;\* but the putrefaction of the disinfected sewage is only delayed, and not ultimately prevented. In fact, the river Nen does eventually become putrid in consequence of the discharge into it of the Northampton sewage; and an injunction has been granted by the Court of Chancery restraining the Improvement Commissioners from discharging the sewage of the town into the river after June 1st, 1870.

“The chloride of iron in solution is manufactured on the premises, at a cost of £6 per ton. A sample of it which we brought away with us contained, in 100,000 parts:—

Iron as perchloride .. ..	4413.7
„ protochloride .. ..	9124.3
Total iron .. .. .	13538.0

“Treatment with Crude Sulphate of Alumina, and subsequent Filtration through Coke.—This process, which is known as Bird’s, is carried out at Stroud, in Gloucestershire. From 150,000 to 200,000 gallons of sewage are daily treated with 6 cwts. of pulverised clay, to which 120 lbs. of sulphuric acid have been added some days previously. The sewage is made to turn a small water-wheel which regulates the delivery from a hopper of the sulphated clay or crude sulphate of alumina, which falls into the stream of sewage on its passage to a settling-

\* Report on the Deodorisation of Sewage, by Hofmann and Frankland, presented to the Metropolitan Board of Works, August 12th, 1859.



tank, whence it flows under a second hopper, from which it receives a second dose of the sulphated clay. Thence it flows into a depositing-tank, and afterwards through three coke filters. The coke is renewed in the first filter every fortnight, and in the last every month. The foul coke is burnt under the boiler.

The condensed results of purification of sewage are expressed, as far as chemical processes are concerned, in the following brief tabulated form:—

Chemical processes.	Average percentage of dissolved organic pollution removed.		Average percentage of suspended organic pollution removed.
	Organic carbon.	Organic nitrogen.	
Best result .. ..	50.1	65.8	100.0
Worst result .. ..	3.4	—	59.6
Average result .. ..	28.4	36.6	89.8

The sections on the purification of rivers from the liquid refuse from manufactories, and that on water-supply, however interesting, are of too local an interest, in this instance, to call for condensation or for an abbreviated account here. The recommendations of the Commissioners are worthy of our notice, and we therefore quote these in full, with the observation, however, that nobody acquainted with what is really meant by, and included in, the term *police*, taken in the scientific sense, can fail to see that the want of sufficient centralisation and power of control given to the Secretary of State for the Home Department, as *ministre de l'intérieur* over all municipal and local authorities, where and whatsoever they be, is at the bottom of the state of matters, caused by ignorant neglect, as well as foul selfishness, and described in these pages. What is absolutely wanted is a strongly and well organised *administration de la sûreté et de la salubrité publique*. As understood and carried out abroad, *Salus populi suprema lex esto*.

"1. That the casting of any solid matters, of whatever kind, into rivers and running waters, or the placing of solid refuse in such positions on the banks of rivers as to render it liable to be washed away by floods, be absolutely prohibited under adequate penalties; and that any act passed for this purpose be made to take effect immediately.

"2. That the discharge of any polluting liquids, such as those defined in the conclusions to this Report, into any river or stream, from any sewer or other outlet, reservoir, tank, or vat, be prohibited under adequate penalties; but that, after the passing of any act prohibiting the admission of polluting liquids into running water, a reasonable time be allowed to corporations, local boards, manufacturers, and others, for the execution of the necessary works for purification.

"3. That all rivers and streams in England be placed under the superintendence of a central authority or board, to be composed of not more than three persons, who shall be duly qualified to deal with all questions connected with the pollution of water and with water-supply.

"4. That it be the duty of this board to see that all enactments relating to the use or abuse of running water be duly enforced; and that, for this purpose, power be given to it to inspect manufactories, reservoirs, sewerage, and other similar works, and to cause to be constructed, at the expense of the owners of the same, whether corporate or private, any necessary purifying-apparatus, in case the said owners neglect or refuse to provide such apparatus for themselves.

"5. That, subject to proper regulations to prevent abuse, additional powers be given to corporations, local boards, manufacturers, and others, to take land compulsorily, under "Provisional Order," for the purpose of cleansing sewage or other foul liquids, either by irrigation, filtration, or otherwise, and to obtain, if required, easements for the construction of culverts and outfalls for drainage through private property, making compensation

only for damage actually done, reserving, however, to the owner the right at any time afterwards, if he could show further damage, to have further compensation.

"6. That it be the duty of the central board to exercise a surveillance over both the quality and quantity of the water-supply of towns; to carefully guard domestic supply from contamination, or, if it be already contaminated, to ascertain the source or sources of injury, and to cause the same to be removed.

"7. That it be the duty of this central board to investigate all schemes for water-supply; and also all proposals for public works connected with river-conservancy, whether initiated by local authorities or by any principal conservancy board of a river-basin either now in existence or to be hereafter constituted; and to report thereon to one of Your Majesty's Principal Secretaries of State."

Our space forbids us to make further extracts from this full and comprehensive report, but we cordially recommend its perusal to all interested in the question. As stated in the prefatory remarks, the report refers to the subject of river conservancy generally as well as to the condition of the particular river basins to which it is professedly confined. The Commission could not have included a more able and earnest worker than Dr. Frankland, and our thanks are due to him and his brother Commissioners, Sir W. J. Denison and Mr. J. C. Morton, for the great scientific skill they have brought to bear on this difficult subject.

## CORRESPONDENCE.

### MANUFACTURE OF SULPHURIC ACID.

To the Editor of the Chemical News.

SIR,—I think it due to Mr. Hofmann, while acknowledging him as the originator of what I expect will become an immense improvement in the manufacture of sulphuric acid, and expressing my thanks for his liberality in freely giving his invention to the chemical world, to give him, and all who feel interested in the matter, my experience in working out Mr. Hofmann's plan with what I still consider my slight improvements in the *modus operandi*.

I am under the necessity of keeping all my chambers at work while gradually making my arrangements for the new mode, as I require the equivalent of 90 to 100 tons of acid of 1.845 out of them weekly; I am, therefore, only partially at work on the new plan, but so far with most encouraging success.

When I commenced operations my consumption of nitrate of soda was exactly 4 tons 2 cwts. weekly. I have reduced down to 3 tons, and my acid is still of good colour, showing sufficient nitre, and last week my production was rather over my average.

I am now preparing for throwing all the SO<sub>2</sub> from my whole series of furnaces into No. 1, and shall then work Nos. 2 and 3, as I am now doing, at 1.715, and without steam; and all the acid from these two chambers, loaded with nitrous fumes, goes back into No. 1, where, mixing with the hot acid of about 1.5, produced by No. 1, into which steam is thrown in large volume, the nitrous acid is evolved and again becomes available, and so is brought back to its work by a process which makes it theoretically almost impossible for it to escape, although practically there must always be a considerable loss. This regular return of the nitrous acid to the first chamber, Mr. Hofmann will, I think, allow to be an improvement on his theory.

I think I see my way to working with 2 tons nitrate instead of 4 tons 2 cwts.—I am, &c.,

P. SPENCE.



## MISCELLANEOUS.

**New Magnesia Burner.**—During a visit which we lately made to the works of the New York Oxygen Gas Co., 547, West 41st Street, we saw a new burner in operation which had just been received from France, and which successfully meets the difficulty previously found in burning the oxygen light, with a very low pressure on the "burning-gas." Each elementary burner consists of three very minute jets, two at either side coming somewhat towards each other, which are supplied with the ordinary gas, and the other between them, and a little shorter, which is fed with oxygen. By this means, no matter how low the pressure on the illuminating-gas may be, no retreat of the flame into the jet can occur. We saw this burner, in fact, operating most excellently with a pressure of about 2-10th inch of water. We hear from Mr. C. H. Stoddard, that a yet further improvement is announced, of which specimens will soon be on hand.—*Communicated by Professor Morton.*

**Use of Calcium Lights at the Saint Louis Bridge.**—From Mr. W. Milnor Roberts, who is in charge of the work, we hear as follows:—"We have used calcium lights only for our open-air work in laying masonry on the top of our caissons—one light on one side, and one at the other, on diagonal corners: we found that they distributed the best light when thus placed. We had the oxygen gas forced into copper gas-holders with a pressure of about 200 lbs. to the square inch. These were carried over from the City to the piers on a little steamer, and the gas was conveyed to the burner through small lead pipe. At first our reflectors were of glass, but so many were broken that they were replaced by metal. A man remained with the two burners through the night, to regulate them occasionally, and to mend the pipes when a burst occurred. They usually burn from eleven to twelve hours; and, with the aid of some movable large reflector lamps, the masons worked as well at night as in the day. The cost of the calcium lights to our company was 3.75 dollars per hour each."—*Communicated by Professor Morton.*

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

*Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

*Comptes Rendus des Séances de l'Académie des Sciences, April 11, 1870.*

This rather small number is chiefly taken up by papers relating to phyto- and zoo-physiology. The papers and memoirs relating to chemistry and collateral sciences are the following:—

**Correction of the Name of a Late Very Celebrated Man.**—Marshal Vaillant deposits several authentic records, from which it appears that the famous natural-historian, Cuvier, was born on August 23, 1769, at Montbéliard, and his birth registered with the Christian names of Jean Léopold Nicolas Frédéric. The Christian name of Georges, by which, while living, this eminent man was known, is not on the official registers.

**Action of Magnetism upon Two Electric Currents which are Made to Pass simultaneously through Space Containing Rarefied Gases.**—L. Daniel.

**Experiments Made with the View to Elucidate the History of Nitric Acid.**—E. Bourgoin.—The author's experiments, described at length, prove that by the reducing action of hydrogen upon nitric acid,  $\text{NO}_5\text{H}_2\text{O}_2$ , there are formed nitrous acid, deutoxide of nitrogen, nitrogen, and ammonia.

**Metallic Tartrates.**—M. Descamps.—The only tartrate described is the double tartrate of sesquioxide of manganese and potassa,  $\text{Mn}_2\text{O}_3 \cdot \text{KO}, \text{C}_8\text{H}_4\text{O}_{10} \cdot 4\text{HO}$ . This salt is obtained by pouring a concentrated solution of bitartrate of potassa, at a temperature of  $40^\circ$ , upon sesquioxide, or, better yet, hydrated binoxide, of manganese; the vessel wherein this operation is carried on should be cooled. The reaction results in the production of a deep red-coloured liquid, which deposits, after filtration and some days' standing, red-coloured crystals of the double salt; the solution referred to is readily decomposed by the action of heat. Even at as low a temperature as  $50^\circ$  or  $60^\circ$  this decomposition begins, but at a higher temperature it becomes violent and instantaneous, being accompanied by a sudden evolution of oxygen; the liquid then becomes colourless, and only contains a salt of the protoxide of manganese. The red-coloured solution is neither precipitated by caustic nor carbonated alkalies; all reducing agents decompose this solution, and the decomposition is accompanied by decolouration of the liquid.

**Aurora Borealis.**—This number contains a valuable series of communications concerning an aurora borealis, observed on the 5th of April in various parts of France and Belgium, over a surface of country stretching from the sea eastward to the Rhine, and from Louvain, Leuven (Belgium), in the north, to no less a distance south than Annecy, in Savoy, the latter being a distance about equal to that from London to Edinburgh.

*Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 2, 1870.*

This number contains the following original papers and memoirs:—

**Zirconium.**—B. Franz.—The author describes first at some length the preparation of pure zirconia on a somewhat large scale by treating the native mineral with bisulphate of potassa, and the decomposition of the sulphate of zirconia, first by fusion with caustic soda, and next by treating the fused mass so obtained with sulphuric acid, and precipitating the zirconia from the aqueous solution of the sulphate by means of ammonia. Metallic zirconium was prepared by the decomposition of the fluoride of potassium and zirconium,  $3\text{KFl} + \text{ZrFl}_4$ , by means of aluminium and a high temperature. The metallic zirconium so obtained is not quite pure, and was found to consist, in 100 parts, of:—Zirconium, 98.34; aluminium, 1.03; and silicium, 0.17. The temperature required for this reduction so as to obtain crystalline zirconium is at least as high as that of the melting-point of copper.

**Expansion of Water (Lecture Experiment).**—F. Rüdorff.—In order to exhibit the effect of the expansion of water when freezing, the author fills with distilled and previously well-boiled and cooled water a cast-iron cylinder having the following dimensions:—Height, 160 m.m.; diameter (external), 50 m.m.; thickness of solid iron, 15 m.m. After having been filled with water this apparatus is closed by means of a plug screwed into the neck, and the cylinder is next placed in a mixture of 3 parts of snow or pounded ice, and 1 part of common salt; after about 40 minutes the cylinder bursts with a loud report. It is essential for the success of this experiment that the plug fits very perfectly, and that the cylinder, after having been filled with water, be placed for some time in ice. The wooden pail which contains the cooling mixture should be rather roomy, and be covered with a stout towel to prevent the spirting about of the contents at the time of the bursting.

**Preservation of Zoological and Anatomical Preparations in Creosote-Water.**—F. Holbein.—The main point of interest in this paper is that specimens collected during journeys may, after having been kept immersed for a shorter or longer time in creosote-water to be made extempore, be dried and packed as if they were minerals.

**Mesohydromellitic and Tetrahydrophthalic Acids.**—A. Baeyer.—Mesohydromellitic acid is difficultly soluble in cold, but readily so in boiling, water; it is a solid crystalline substance; at  $130^\circ$  it loses two equivalents of water, and becomes anhydride of mesohydromellitic acid,  $\text{C}_{12}\text{H}_8\text{O}_{10}$ . Tetrahydrophthalic acid fuses at  $95^\circ$ ; the author states that he is engaged in further researches on this subject. This paper contains a series of very complicate formulæ which serve to illustrate the constitution of the bodies alluded to, but space forbids us to re-produce these formulæ here.

**Withdrawal of Water (Wasserentziehung), and its Bearing upon Vegetable Life and Fermentation.**—A. Baeyer.—This lengthy paper is divided into the following main sections:—Anhydride formation; condensation; phenomena of fermentation.

**Products obtained from Crude Malt Spirits by Distillation.**—G. Krämer and A. Pinner.—The authors first refer to some former researches on this subject, reminding that raw or crude spirits (a rather strong alcohol is alluded to) contains large quantities of aldehyde acetal, and croton aldehyde; and they have further discovered, in the so-called fusel oil, isobutyl alcohol, ethyl alcohol, and propyl alcohol.

**Vapour Density of Acetic Acid.**—A. Horstmann.—This paper is not suitable for abstraction. It contains a series of algebraic formulæ and tabulated results of the vapour density of the acid referred to from  $12.4^\circ$  to  $63.1^\circ$ .

**Solid Bisulphide of Carbon.**—Dr. V. Wartha.—Already referred to by us (see CHEMICAL NEWS, vol. xxi., p. 131).

**New Locality where Diamonds have been Discovered.**—G. Rose.—The author refers to the diamond found at Dlaschkowitz, a village in Bohemia. The facts are known to our readers from the abstracts from the *Comptes Rendus* for this year.

**Cause of the Emission of Light by Phosphorus.**—W. Müller.—This very lengthy memoir treats on the question, whether the emission of light by phosphorus is due to its oxidation, or whether



it is caused by its volatilisation. A lengthy series of experiments is minutely described; and the main result arrived at is, that, since phosphorus is not oxidised by oxygen under normal conditions, and its emission of light increased by withdrawal of the pressure of air, it would appear that the luminosity of this substance is in some way connected with its volatilisation.

**On Tetraphenol,  $C_4H_4O$ .**—H. Limpricht.—This substance was obtained by the distillation of an intimate mixture of pyromucate of barium and 0.9 parts of soda lime. Tetraphenol is a colourless liquid, insoluble in water, boiling at  $32^\circ$ , and evaporating so rapidly at ordinary temperature, that a portion of a drop on a glass rod is solidified by the cold produced by the evaporation of the rest.

**Use of Hypobromite of Baryta as a Reagent.**—W. Knop.—This paper treats on the use of the hypobromite of baryta for the detection of ammonia, but the author's experiments on this subject are not quite complete as yet.

Cosmos, April 9, 1870.

**Causes of Steam-Boiler Explosions.**—J. Georges.—This author, a mechanical engineer and boiler-maker, states that his experience has taught him that the bursting and exploding of steam-boilers is chiefly due to defects in the iron plates used in the construction of these apparatus; and his proposal is, that, instead of testing boilers under pressure, as is usual, by means of hydraulic appliances, the plates should be tested at the iron-works, and stamped by the *garde-mine*, if found of sufficiently good quality for use for the construction of boilers. (The *garde-mine* is, in France, an official who might be termed, in English, a viewer of mines; but his education, practical as well as theoretical, is far more extensive, and under the *Ingénieurs des Mines* for each district; the supervision of stationary steam boilers, and of all manufactories connected with mining and metallurgical operations, is also confided to him.)

**Laboratory Accident.**—A short time ago, the inmates of the Hôtel-Dieu were greatly disturbed by a severe explosion, which shook the large building. On ascertaining the cause, it was found that the chemical laboratory of that establishment was the scene of the disaster; and among the heap of ruins into which this place was converted was found the almost lifeless body of a young student, who had repaired to the laboratory for making some preparation of oxygen (so the French text reads). As he was severely wounded and quite unconscious, the cause of the explosion has not been ascertained. As a matter of course, the whole place was in flames also; but the *pompiers* on duty at the Hôtel de Ville succeeded in quenching the flames in a few minutes, by the aid of the hydrants in the building.

**Imperial Agricultural College.**—On the 1st of July next will be inaugurated another of these establishments, which have proved highly useful. The College here alluded to will be the first of the kind in the southern parts of France, and be established close to the city of Montpellier, where a site of some 25 hectares (about 62 acres) of land has been allotted for the purpose.

April 16, 1870.

**Decimal System of Weights and Measures.**—We learn that the two Representative Assemblies of the Kingdom of Wurtemberg have unanimously approved of the proposition made by the Ministry, as regards the adoption in that Kingdom of the decimal system of weights and measures, which becomes compulsory also for coinage from the first of January, 1872.

**Nature of the Sun.**—G. Bernaerts.—The first instalment of a rather lengthy, yet very interesting, paper on this matter, wherein is compiled all recent researches on this subject.

**Increase of the Number of Inhabitants of Large Cities and Towns.**—Although not belonging to the subjects generally treated in our paper, we may not omit to mention an astonishing fact. Leaving other particulars, we only quote that whereas, in the year 1832, Berlin was, in relation to the number of its inhabitants, the eighth in the order of the European capitals, it is now the third; its population in 1832 was 250,000, and in 1869 (end of year) it was 800,000, an increase at the rate of 220 per cent. Of all the capitals of Europe, the increase of population of Amsterdam during that time was the smallest, being only at the rate of 12 per cent. The next largest percentual increase of Berlin is that of Liverpool, at the rate of 174 per cent.

Les Mondes, April 7, 1870.

**Foundation of a Chair of the History of Medicine and Surgery at the Medical Faculty of Paris.**—Since authorisation has been received to accept the legacy of £6000 bequeathed by M. Salmon de Champoreau for the foundation of the chair above named, there will be shortly an election of a properly qualified lecturer for this office.

**National Congress for Geographic, Cosmographic, and Commercial Sciences, at Antwerp.**—During the month of August next, there will be a meeting at the city alluded to, and among the principal subjects for discussion are—The astronomical past and future of our globe, its own heat and its cooling down; is it possible to draw, from the laws which rule these phenomena, conclusions relating to the economy of fuel, and to the influence which the hand of man has brought about by the draining of marsh-grounds and lakes, the cultivation of forest on mountains and plains, the formation of inland seas, &c.; adoption of the same *first* meridian; adoption of the same system of measures for use in daily life, as well as for scientific

use; anthropology, in its relation to geography. Among the desirable works to be executed in the interest of all the civilised nations of the world, the congress desires discussion on the piercing of the Isthmus of Panama; railway towards Persia and India along the Euphrates valley, and conversion of the Desert of Sahara into an inland sea. There will be held at Antwerp, during the meeting, an exhibition of objects relating to geography, ethnography, and commerce.

**Black Snow.**—M. Feltz.—The author, who resides at Arlovetz Russia, states that, during a severe gale of wind from the north-east accompanied by a snow-storm, there fell, on the 31st of January last, between 2 and 4 p.m., a quantity of a blackish coloured substance, strongly contrasting with the peculiar brightness of the previously-fallen snow. On examining this powdery substance more particularly, it was ascertained to be arable soil, which, as was afterwards learnt, had been carried by the violence of the wind for a distance of many miles. The quantity of this soil, dried at  $100^\circ$ , was found to be 6.5 grms. for a surface of a square metre; and, since it was found that, at the very least, a surface of 10 square kilometres (3.86 English square miles) had been covered to the same extent with this dust, the quantity thereof carried by the violence of the wind amounted to at least 650,000 kilos. = 650 tons' weight.

**Foundation of a Laboratory for Medical Chemistry.**—Dr. G. Le Bon.—In imitation of what has been successfully accomplished in Germany, the author has established a laboratory for the special purposes of testing, analysing, and experimenting in physiological and pathological chemistry, in connection with microscopical observations and other requirements of modern medical science.

April 14, 1870.

**Cerebral Activity, and the Relation the Composition of Urine bears thereto.**—Dr. Byasson.—According to a series of accurately-made experiments, the author having himself been the subject of such trial, he states that cerebral activity is accompanied by a more abundant production of urea, and alkaline phosphates and sulphates; while muscular activity is accompanied by the increased production of urea, uric acid, and chloride of sodium. The author's full researches are recorded in his inaugural thesis, sustained before the medical faculty at Montpellier.

*Revue des Cours Scientifiques de la France et de l'Etranger*, Nos. 19 and 20, 1870.

Neither of these numbers contain any original papers relating to chemistry; the last-named contains an excellent and full account of a lecture on the—

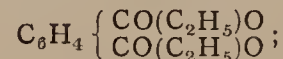
**History and General Properties of Blood.**—Claude Bernard.—This lengthy paper treats on this most important subject, commencing from the earliest days of existing written records, and fully entering into physiological as well as chemical details.

*Annalen der Chemie und Pharmacie*, March, 1870.

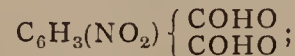
This number contains the following original papers and memoirs:—

**Chemical Nature of the Xylol contained in Coal-Tar.**—R. Fittig.—The gist of this very lengthy paper is that xylol, whether obtained from coal-tar or from other sources, is a mixture of various bodies.

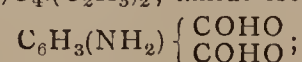
**On Isophthalic Acid and some of its Derivatives.**—H. E. Storrs and R. Fittig.—The authors describe:—Isophthalic-acid ethyl ether—



Nitro-isophthalic acid—



Nitro-isophthalate of calcium and barium; nitro-isophthalic-acid ethyl ether,  $C_8H_3(NO_2)O_4 \cdot (C_2H_5)_2$ ; amido-isophthalic acid—



Hydrochloro-amido-isophthalic acid,  $C_8H_5(NH_2)O_4 \cdot HCl + H_2O$ ; sulphuric-amido-isophthalic acid,  $[C_8H_5(NH_2)O_4]_2H_2SO_4$ .

**On Amido-dicyanic Acid.**—F. Hallwachs.—This memoir is divided into the following sections:—Preparation of amido-dicyanic acid; amido-dicyanate of silver,  $C_2N_3H_2AgO$ ; amido-dicyanate of copper,  $C_2N_3H_2CuO + 2H_2O$ ; and a series of other salts. The structural formula of amido-cyanic acid is—



**On Sulpho-Cyanogen Compounds.**—Dr. L. Glutz.—This lengthy essay is divided into the following parts:—Behaviour of sulpho-cyanide of ethyl with concentrated hydriodic acid; derivatives of sulpho-cyanogen ethylen; rhodan ethylsulphinchloride.

**On some of the Derivatives of Oxybenzoic Acid.**—Dr. A. K. Heintz.

**On Ethyloxybenzoic Acid.**—G. Rosenthal.

**On Thionessal, Tolallylsulphide, Lepiden, and Oxylepiden.**—Dr. J. Dorn.

**Synthesis of an Acid Homologous with Cinnamic Acid.**—R. Fittig and P. Bieber.

**On Molybdic Acid and Compounds thereof.**—F. Ullick.—This paper, like all the foregoing of which the titles only are quoted, is an essay and monograph, and far too long for any useful abstraction.



*Polytechnisches Journal von Dingler*, first number for March, 1870.

This number contains the following original papers relating to chemistry and collateral sciences:—

**Separator for Water and Steam.**—C. von Witzleben.

**Improved Evaporator for Saccharine Juices.**—M. Schreiber.—Although the contents of these two papers, illustrated by diagrams, do not exactly belong to chemistry, the contrivances described are so useful that we translate the titles.

**Furnace for the Proper Combustion of Pulverulent and Wet Fuel.**—A. Koch.—Illustrated with engravings.

**Researches on the Coals of Upper Silesia (Prussia).**—Dr. H. Fleck.—This very extensive and exhaustive monograph is a very valuable addition to our knowledge of coals, from a scientific as well as industrial and technical view of this subject.

**Alterations Coal undergoes when Exposed to Air.**—Dr. E. Richters.—A continuation of the former portion of this author's paper, containing the following sections:—On the causes of the spontaneous combustion of coals; difficultly-combustible coals; readily-combustible coals. This paper is to be continued.

**Estimation of the Average Size of Starch-Globules.**—Dr. Schönn.

**Method of Obtaining the Oxalic Acid contained in Madder.** M. Pernod.—When madder is converted into garancine, the oxalate of lime present naturally in madder is decomposed by the sulphuric acid. The oxalic acid thus set free was hitherto lost in the wash-waters; these fluids are now run into suitably-constructed tanks, and saturated with hydrate of lime, which causes the formation of a large quantity of precipitate of oxalate of lime. This salt is collected, and decomposed by sulphuric acid, carefully added, so as just to be sufficient for the combination of that acid with lime. The sulphate of lime is separated by filtration through flannel, and the solution of oxalic acid evaporated in leaden pans, re-crystallised, and fit for the market. The quantity of this acid thus obtained will vary according to the kind and quality of the madder; and it should be observed, also, that the Avignon madder, employed by the author, contains naturally a large quantity of lime—a base which greatly influences the formation of acids in plants in general, and oxalic acid especially.

Second number for March, 1870.

This number contains the following original papers relating to chemistry and collateral sciences:—

**Manufacture of Ice for Industrial Purposes.**—Dr. R. Schmidt.—A paper chiefly treating on the cost of machinery and ingredients required for the making of ice for breweries and other places where it is required in large quantities.

**Action of Sulphuretted Hydrogen upon Manganese Compounds.**—A. Wagner.—The contents of this paper relate to a series of experiments made with the view to ascertain whether the hydrated oxide of manganese is preferable to hydrated peroxide of iron for the purpose of the gas-purification process. It appears, from the author's statements, that the iron preparation is in every respect to be preferred for this purpose.

**Bleaching of Yarns and Woven Fabrics with the Permanganates of Potassa and Soda.**—A. Pubetz.—The contents of this paper are only interesting to bleachers of linen and cotton materials.

*Annales des Mines*, No. 6, 1869.

This number contains the following original papers and memoirs:—

**Mines and Metallurgical Manufactories of the Banat (a portion of Hungary).**—M. Castel.

**Additional Notes to a Memoir on the Present State of the Metallurgy of Lead.**—L. Grüner.

**On some Minerals Found in Chili.**—M. Domeyko.—*Tungstate of Copper.*—In 100 parts:—Tungstic acid, 56.48; oxide of copper, 30.63; lime, 2.0; oxide of iron, 2.53; silica, 3.87; water driven off at red heat, 4.62. *On the Titaniferous Sand of the Chilian Sea-board, and on the Origin of that Sand.*—The analysis of two varieties of this sand is quoted per centically, care being taken to analyse separately the magnetic and non-magnetic portions. The following quotation will give an idea of the composition of this material as met with at Punta Arenas (on the Straits of Magellan):—Non-magnetic portion—Titanic acid, 19.2; protoxide of iron, 29.7; peroxide of iron, 49.7; lime, 0.9; magnesia, 1.0. Magnetic portion—Titanic acid, 22.8; protoxide, 15.8; peroxide of iron, 61.5.

**Mineral Resources of the Ariège.**—M. Mussy.—A lengthy monograph of one of the Frontier Departments of France, bound by Spain and the ancient Republic of Andorra.

*Journal für Gasbeleuchtung*, March, 1870.

**Bicarbonate of Ammonia in Illuminating-Gas.**—Dr. Rüdorff.—The author states that, during the very severe cold which prevailed at Berlin in the month of February last, a quantity of crystals were found deposited in the purifiers of one of the gas-works at Berlin. The substance exhibits a distinctly-crystalline, well-defined, rhomboprismatic structure. On analysis, the author found, as the average of three experiments, this compound to correspond with the formula  $\text{NH}_4\text{HCO}_3$ , containing 21.52 per cent of ammonia. The crystals are interesting, since it has been hitherto found impossible to prepare this bicarbonate artificially.

**Regulation for Securing the Use of Gas with Safety, and Advice as regards the Arrangements of the Gas-Fittings in Dwelling-Houses, Offices, and Public Buildings for Carlsruhe (the Capital City of Baden).**—This paper contains some very useful suggestions for the safe employment of gas in general.

## NOTES AND QUERIES.

**Detection of Strychnia in Organic Matter.**—Can any of your readers inform me where I can find a description of Stas's process for the detection of strychnia in organic matter.—ALPHA.

**Chlorate of Soda.**—"W. H." is referred to Brande's "Manual of Chemistry, vol. i., pp. 563, 609. This work may be inspected at the Library of the Commissioners of Patents.

**Wood-paper.**—I observe in an advertisement in the CHEMICAL NEWS that Dr. Moffat mentions wood-paper in a list of his investigations. Being anxious for information on the subject of wood-paper, I should feel greatly obliged if the learned Doctor would kindly let me know where his investigations are published. Has any other celebrated chemist devoted attention to the subject?—A. B. C.

**Sulphate of Ammonia.**—(Reply to "A Working Man.")—When chloride of ammonium is used for the purpose you allude to, 5 parts of that salt, previously powdered, are mixed with 4 parts of slaked lime, and the mixture is moistened so as to form lumps when squeezed in the hands. With sulphate of ammonia you should take equal parts by weight of both lime and the sulphate (a slight excess of the former is preferable), and water as just stated. Sulphate of ammonia only yields 23 per cent of ammonia gas, whereas sal ammoniac yields 32 per cent.

**Latent and Sensible Heat.**—It is a well-known fact that copper and spelter when brought together, as they are in making brass and yellow metal, generate a large amount of heat in excess of that which they had separately or collectively possessed before. Now, I would feel it a great kindness if you would inform me what this excess of heat amounts to, and how it is accounted for. Suppose, for example, 60 lbs. of copper at its point of liquefaction, or 1996° F., and 40 lbs. of spelter at say 720°, or its point of liquefaction, were put together, what would be the degree of heat or the temperature of the compound?—COMPOUND.

**Continuous Current of Air.**—In your last number I am reported to have told the Chemical Section of the Glasgow Philosophical Society in my paper on "A Method for Obtaining a Continuous Current of Air, &c.," that, from calculations made, I had no doubt that, with a Herapath lamp, I could get a blast quite as strong as that obtained by using the Griffin lamp. As nearly as I can remember, what I *did say* was that "I was not possessed of a Griffin lamp. But I did not think the blast of air obtained by this apparatus would be sufficiently strong to consume the gas delivered by one; because, with a Herapath lamp, the blast of air obtained was just sufficient to maintain a blue flame when the gas stopcock was full open, and the pressure in the main not greater than 27 mm., or so." By giving this correction a place in your next issue you will greatly oblige.—T. L. PATTERSON, Greenock, April 18th, 1870.

## MEETINGS FOR THE WEEK.

- MONDAY, 25th.—Medical, 8.  
— Geographical, 8.30.  
— Philosophical Club, 6. Anniversary.
- TUESDAY, 26th.—Institution of Civil Engineers, 8.  
— Ethnological, 8.  
— Royal Institution, 3. Prof. Blackie, "Principles of Moral Philosophy."
- WEDNESDAY, 27th.—Geological, 8.  
— Society of Arts, 8.  
— London Institution, 12. Anniversary.
- THURSDAY, 28th.—London Institution, 7.30.  
— Zoological, 8.30.  
— Royal, 8.30.  
— Royal Society Club, 6.  
— Royal Institution, 3. Prof. Tyndall, "On Electricity."
- FRIDAY, 29th.—Zoological, 1. Anniversary.  
— Royal Institution, 8. Prof. Blackie, "The Interpretation of Popular Myths."
- SATURDAY, 30th.—Quekett Microscopical Club. Excursion to Wimbledon. To meet at Waterloo Station at 2 p.m.  
— Royal Institution, 3. Prof. Grant, "Astronomy of Comets."

## TO CORRESPONDENTS.

*James Bebbington.*—Metallic cobalt is not found native, neither is it met with in commerce except as a scientific curiosity.



# THE CHEMICAL NEWS.

VOL. XXI. No. 544.

## NOTE ON THE DOUBLE ARSENIATE OF MAGNESIA AND AMMONIA.

By FREDERICK FIELD, F.R.S.

MANY years ago I published in the *Quarterly Journal of the Chemical Society*, vol. xi., p. 6, a paper "On the Composition of the Double Arseniate of Ammonia and Magnesia," after a long investigation of the subject. Mr. E. W. Parnell in the *CHEMICAL NEWS* (vol. xxi., p. 133), has also written an elaborate memoir on the same substance, and he arrives at the conclusion that at about a temperature of 90° C. ammonia escapes, but more than one equivalent of water is retained, while at a temperature of from 100° to 110° C. this excess of water, and probably more ammonia are driven off, and, therefore, considers that no definite compound of arsenic can be obtained by drying the precipitate at a temperature at all suitable for counterpoised filter.

Without impugning for one moment the accuracy of Mr. Parnell's analyses, my own experiments seemed so fully to corroborate the excellence of Levot's method for the estimation of arsenic by the formation of the double arseniate, recognised as most satisfactory both by H. Rose and Fresenius, and recommended by those chemists, that I was led to study Mr. Parnell's experiments attentively to see if our methods of working were identical. In referring to the *Quarterly Journal of the Chemical Society*, vol. xi., p. 13, it will be found that it is very necessary to be extremely cautious in the desiccation of the substance in question. Specimens dried upon a filter placed above a sand bath with a thermometer suspended at the same distance from the heated surface (the mercury never rising above 300° F.) were found to have lost the whole of their water in from four to five hours, and from more recent experiments it has been proved that no water can exist even at 230° F. Again, it is stated on the same page, "like the corresponding lime salt, it loses water at a slight increase of temperature (the lime salt loses its equivalent of water at a little above 212° F.)."

Now, upon a careful perusal of Mr. Parnell's paper it appears that a constant temperature of 100° C., except in one instance, was not employed, the thermometer ranging from 90° to 110° C. He is, therefore, quite correct in saying that at 90° more than one equivalent of water is retained (*vide Quarterly Journal of the Chemical Society*, vol. xi., p. 13), and also that from 100° to 110° C. the excess of water is driven off.\*

Mr. Parnell obtains, in one experiment, where the arsenic has been thoroughly oxidised, by the passage of chlorine through the arsenic acid solution, 0.1690 of arsenious acid from 0.3244 of the double arseniate, a result, he observes, far too low, and which leads him to believe that the formula  $(\text{AsO}_4, \text{MgNH}_4\text{O})_2\text{H}_2\text{O}$  does not represent the composition of the compound after being dried at 100°—110° C. Certainly it does not, for the composition of the double arseniate above 100° C. contains no water, and the calculated quantity of arsenious acid obtained by drying the arsenical compound above 100° C. should be 0.173, not very much above Mr. Parnell's figures. Again, when 1.0152 grms. of air-dried compound were heated in the air bath, at a temperature of 100°—110°, the mean loss by weight in three experiments gave Mr. Parnell 37.86 per cent. In my experi-

ments the loss was 37.41, no very great discrepancy, when reduced to percentages.

With regard to the evolution of ammonia at temperatures under 100° C., I confess it is a matter of grave interest, and has escaped the observation of all former analysts. Rose himself has given the formula of the compound dried at 100°  $(\text{NH}_4\text{O}, 2\text{MgOAsO}_5)\text{HO}$  (old notation), and this has been corroborated by many chemists. I have always noticed the smell of ammonia, and its action upon litmus, when drying the substance, but concluded that it arose entirely from the liquid in which the precipitate was washed upon the filter, and which was always made strongly alkaline, as the double arseniate is far more insoluble in ammonia than in either water or chloride of ammonium.

Mr. Parnell's experiments, therefore, in some respects coincide with my own, inasmuch as he proves that under 100° C. more than one equivalent of water exists, and that above that temperature, according to his own figures (with a slight margin for necessary error), no water exists.

## ON CONSECUTIVE POLES IN A MAGNET.

By CHARLES TOMLINSON, F.R.S.

IN the *CHEMICAL NEWS* (vol. xxi., p. 164) is an account, by Mr. Porter, of some "curious results in the shape of magnetic phenomena." These results refer to the production of what are called, by English writers on magnetism, *consecutive poles*; by the French, *points conséquens*; and, by the Germans, *Folgepunkte*. Although the phenomena which accompany their production are interesting and instructive, they are scarcely noticed in the modern treatises that are in general circulation. Snow Harris, in his "Rudimentary Magnetism," does not describe them, probably for the reason given by Becquerel ("Traité de l'Électricité," vol. i., p. 73)—that a needle containing consecutive points is worthless in observations on terrestrial magnetism. Some of the old treatises give a sufficient account of them; thus, in Cavallo's "Treatise on Magnetism" (second edition, 1795), the following passage occurs at p. 186:—"The magnetic centre, or the limit between the polarities, is not always in the middle of the bar; it is generally nearer that end which is presented to the magnet. This difference is greater as the magnet is weaker and the length of the bar increases; but, when the bar exceeds a certain length (which depends on the strength of the magnet), then the bar acquires several successive poles—viz., when the north pole of the magnet is contiguous to one of its extremities, that extremity becomes a south pole; a few inches farther on you will have a north polarity; then another south polarity, and so on. In this case, the first magnetic centre comes very near that end of the bar which stands next to the magnet, and other magnetic centres are formed between every pair of successive poles: those successive poles become weaker and weaker in power, according as they recede from that end of the bar which is contiguous to the magnet; so that, in a pretty extended bar, they quite vanish long before they come to the farther end of it. Hence, if one pole of a magnet be applied to the end of a long bar, the other end of the bar will not thereby acquire any magnetism."

An effect of this kind may be well shown by magnetising one-half only of a steel knitting-needle about nine inches long.

*Experiment 1.*—Place a steel knitting-needle on the table, and press it down firmly, by means of a finger, in the middle of its length; then draw the south pole of a strong magnet along the wire, from the finger to the end, about six or eight times, bringing the pole, after each touch, with a wide sweep of the arm, back to the finger. If now the wire be tested, by holding it vertically near a horizontal magnetic-needle, the end of the touched

\* In Mr. Parnell's paper, "the excess of water and probably more ammonia."



half will be found to be N.; while the S. pole will be somewhere within the wire, at about 5 inches from the N. pole, and the rest of the wire inactive. On dipping the N. end into iron-filings, a considerable bunch will be taken up. On dipping the other end into the filings, it will attract none of them, until the filings reach the wire at and about S. (Fig. 1), where a large bunch will be taken up.

FIG. 1.



This experiment may be varied by rubbing the N. or S. pole of a strong magnet over about an inch or two of the central portion of a knitting-needle 9 inches long. All three poles will be within the wire, an inch or more at each end being magnetically inactive.

The following experiment will show the action of consecutive poles:—

*Experiment 2.*—A bar-magnet, 6 inches long and  $\frac{1}{2}$  inch wide, was touched six times on its marked or northern half with the north end of a strong magnetic battery. On passing the bar horizontally before a small dipping-needle, the marked end of the bar strongly attracted the marked end of the needle. At the distance of  $1\frac{1}{2}$  inches from the marked end of the bar, the needle suddenly swung round, and presented its S. pole to the bar, and continued to do so until a part of the bar,  $1\frac{1}{4}$  inches from the other end, arrived opposite the needle, when this again swung round, and presented its N. pole to the bar for the remainder of its length.

*Experiment 3.*—The bar being placed on the table, and covered with a sheet of white paper, iron-filings were gently sifted upon it. The resulting figure was very good, showing the poles and neutral lines distinctly. Fig. 2 represents roughly the conditions of the case—

FIG. 2.



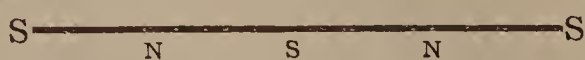
A similar case being produced in a knitting-needle—

*Experiment 4.*—The needle was broken in the middle, when each fractured end remained a N. pole, the other two ends S. poles, and the neutral point was in the centre of each fragment.

Although, theoretically, the pole is a point situated some way within each end of the bar, in which point all the forces of one kind or other are supposed to be collected (just as the centre of gravity is a point within a body in which all the weight is supposed to be collected), yet, in practice, each half of the bar is often referred to as a pole; and, in the case before us, a considerable portion of the centre of the long wire may be taken as a north pole, bounded on either side by a neutral line, and by a considerable portion of each end which forms a south pole. The extent of north pole in the central portion of the wire is such that it may (as in Experiment 4) be cut through without disturbing the arrangement, each half being now a complete magnet, with the poles and neutral line arranged exactly as they were before the separation; and, further, when the severed ends are brought together, and iron-filings dusted over the whole length, the same figure is produced as before the separation.

*Experiment 5.*—A knitting-needle was placed on white paper, and the first quarter of its length rubbed with the north pole of a bar-magnet, the second quarter with the south pole, the third with the N., and the fourth with the S. The result of this operation was a needle with five poles—

FIG. 3.



Consecutive poles are due to several causes—such as an over-exertion of the coercitive force, as when we attempt to saturate a bar of steel of too great a length.

According to Coulomb, consecutive poles are always formed in needles of tempered steel, where the length exceeds thirty times the diameter. Or, if the steel be of too hard a temper, or of unequal temper, these points are likely to occur from the unequal distribution of the coercitive force. In some cases, they may be made to disappear by a careful re-magnetisation.

According to Coulomb, the neutral line is always brought some millimetres nearer the part of the bar last touched. This may be roughly but strikingly shown by restoring the bar-magnet (Fig. 2) to its natural condition as to polarity.

*Experiment 6.*—Pass the S. pole of a powerful magnet three or four times over the marked end of the bar (Fig. 2). The two consecutive poles will disappear; but the neutral point will be at about 2 inches, instead of 3, from the marked end, as in Fig. 4.

FIG. 4.



*Experiment 7.*—Pass the N. pole of the magnet two or three times over the S. end of the bar (Fig. 4), and the neutral point will be at, or very near, the centre.

When a long, magnetised knitting-needle has one of its poles reversed, and two consecutive poles formed, the neutral points are not distributed symmetrically.

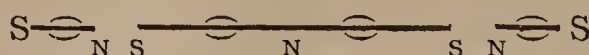
*Experiment 8.*—Rub the N. pole of the magnet over the N. end of the needle about three times. The needle will have a S. pole at each end, and the N. pole spread over the centre. The neutral lines will be at  $1\frac{1}{4}$  inches from the original S. pole, and  $2\frac{1}{2}$  inches from the reversed N. pole, as in Fig. 5.

FIG. 5.



*Experiment 9.*—Cut off the two ends of Fig. 5 a little on the S. side of each neutral line. The central portion will be constituted as before—viz., with two extreme S. poles and two inner N. poles, only the neutral points will be brought nearer together. Each of the end fragments is a perfect magnet, with the S. poles undisturbed and the N. poles at the fractured ends, the neutral point being in the middle. Each end of the central piece will lift each fragment by the broken end, and the three pieces being put together in proper order appear thus:—

FIG. 6.



*Experiment 10.*—Rub N. pole of battery over the N. end of one of the short pieces ( $2\frac{1}{2}$  inches long) marked S. N. The effect is simply to reverse the poles, without producing consecutive ones.

If a similar experiment be performed on a regularly magnetised wire not under about 4 inches long, the effect will not, in general, be simply to reverse the poles, as in Experiment 10, but to produce a pole of the same name at each end, while the pole of opposite name occupies the middle portion of the wire, as in Figs. 2 and 5, and the central portion of Fig. 6. Only it must be observed that, in magnetised pieces of steel wire of about 4 inches in length, the end rubbed with the pole of a strong magnet may so far disturb the arrangement of the neutral lines that one may come very near one end, so as to make it somewhat difficult to detect the two poles which such line separates, at least by the dipping-needle or horizontal-magnet test. The figure formed by gently dusting iron-filings over it is an elegant and good test.

*Experiment 11.*—A magnetised wire,  $4\frac{1}{2}$  inches long, had its northern half rubbed with the N. pole of a strong magnet. Fig. 7 represents the magnetic wire before this treatment, and Fig. 8 the result of the treatment. It will be seen from Fig. 8 that the neutral point on the side

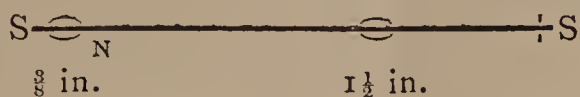


rubbed is  $1\frac{1}{2}$  inches from the rubbed end, while the other neutral point is only  $\frac{3}{8}$  inch from the other end.

FIG. 7.



FIG. 8.



I trust the majority of the readers of the CHEMICAL NEWS will excuse the rudimentary nature of the foregoing details into which I have been tempted by what I think are the insufficient descriptions of Mr. Porter. The student may find amusement and instruction in repeating and devising such experiments as have been described. The apparatus required does not necessarily consist of more than a sixpenny horseshoe-magnet, a small compass-needle, a few thin steel knitting-needles, some iron-filings contained in a gauze bag or in a small sieve, and a sheet or two of writing-paper. In order to bring out the effects strongly, I used a magnetic battery, capable of lifting about 20 lbs. weight, for magnetising the wires, and a small, delicately-poised dipping-needle for testing them; but nothing can be more graphic than the iron-filings test, and the filings may be gently dusted on the wire itself or on the white paper placed upon it, assisting the figure, if necessary, by a few taps under the table.

Highgate, N., April 18th, 1870.

# ON NITRIC ACID AND CHLORATE OF POTASSIUM AS AN

OXIDISING MIXTURE APPLICABLE TO SULPHUR, SULPHIDES,  
CHROMIUM, ARSENIC, ORGANIC MATTERS, &C.

By FRANK H. STORER,

Professor of General and Industrial Chemistry in the Massachusetts  
Institute of Technology.

SOME years since, while studying the action of various oxidising agents upon oxide of chromium, I was struck by the superior oxidising power of a mixture of ordinary nitric acid and chlorate of potassium over that of the mixtures of chlorate of potassium and chlorhydric or sulphuric acid commonly used in analysis. Inasmuch as the fact of the great oxidising power of a mixture of nitric acid and the chlorate had already been noticed and explained by several observers,\* I at that time contented myself with a simple statement of my own observations of the action of the mixture upon chromic oxide,† without referring in any way to the general value of the mixture as an oxidising agent. Since that time, however, I have had frequent occasion to employ the mixture for effecting the oxidation of many substances besides oxide of chromium, such as present themselves in the ordinary experience of an analytical laboratory, and have satisfied myself that the merit of the process has not hitherto been duly appreciated.

Experience has convinced me, not only that a mixture of nitric acid and chlorate of potassium oxidises more rapidly than the common mixture of chlorhydric acid and chlorate of potassium, but that it is really to be preferred, in the great majority of cases, to any of the agents ordinarily employed to effect oxidation in the wet way. Instead of occupying, as now, a secondary or alternative place in the treatises on analysis, it ought to take precedence of the other processes of oxidation. It may be used with advantage in many instances where dry methods

of oxidation are now recommended. With the exception perhaps, of the sulphides or other compounds of antimony and tin, there are probably but few cases where its use will be found inadmissible.

The following notes include the results of several researches made by students of the Massachusetts Institute of Technology with the view of testing the capabilities of the process:—

## Estimation of Sulphur in Organic Compounds. By A. H. PEARSON.

It is easy to determine sulphur in non-volatile organic compounds, by oxidising the substance with chlorate of potassium and nitric acid, precipitating the sulphuric acid as sulphate of barium, and washing the latter with a solution of acetate of ammonium, to remove any nitrate of barium which may have adhered to it.

To oxidise the sulphur compound, place a weighed quantity of it in a porcelain dish, pour upon it three or four table-spoonfuls of strong nitric acid ( $39^{\circ}$  B.), free from sulphuric acid, and add to the acid half a tea-spoonful of chlorate of potassium. Cover the mixture with an inverted glass funnel, the stem of which has been bent to a right angle. Place the dish on a wire-gauze support, and heat its contents. From time to time, lift the funnel slightly, and throw a small fragment of chlorate of potassium into the hot acid.

The funnel must be of such size that its rim may fall within the rim of the dish, and rest securely upon the sides of the dish, above the liquid. It serves to retain the particles of liquid which are thrown up from the dish by the gas evolved during the decomposition of the chlorate.

The oxidation will be completed more or less rapidly, according to the character of the substance operated upon. Only five or ten minutes are required to completely oxidise a third of a gramme of sulphocyanide of potassium, while from half to three-quarters of an hour are needed to destroy the same weight of ordinary free sulphur. It may be observed, in passing, that sulphur which has just been distilled dissolves twice as rapidly in a mixture of nitric acid and chlorate of potassium as sulphur which has long been exposed to the air.

Several samples of sulphocyanide of potassium, oxidised in this way, gave the following results:—

- A. 0.2015 grm. of the sulphocyanide gave 0.5114 grm. of sulphate of barium. (I.)
- A. 0.265 grm. of the sulphocyanide gave 0.6547 grm. of sulphate of barium. (II.)
- B. 0.149 grm. of the sulphocyanide gave 0.3796 grm. of sulphate of barium. (I.)
- B. 0.012 grm. of the sulphocyanide gave 0.03 grm. of sulphate of barium. (II.)
- C. 0.101 grm. of the sulphocyanide gave 0.2387 grm. of sulphate of barium.
- D. 0.028 grm. of the sulphocyanide gave 0.067 grm. of sulphate of barium. (I.)
- D. 0.084 grm. of sulphocyanide gave 0.204 grm. of sulphate of barium. (II.)

The sulphocyanide used for the experiments mentioned in the paragraphs marked "A" was prepared by fusing together ferrocyanide of potassium, carbonate of potassium, and sulphur, in the usual way, treating the fused mass with hot alcohol, and allowing the alcoholic solution to crystallise. That used for the experiments in paragraphs B was prepared in precisely the same way as the foregoing, but at another time. The salt prepared in this way is evidently contaminated with free sulphur, or some sulphur compound other than the sulphocyanide which has been taken up by the alcohol.

The experiment recorded in paragraph C was made with crystals which separated from the alcoholic mother-liquid of B.

The experiments marked D were made with purified crystals, obtained as follows:—A quantity of the crude

\* Compare Gmelin's "Handbook of Chemistry," vol. iii., p. 61.

† *Proceedings of the American Academy*, 1859, vol. iv., p. 342; *Journal für Praktische Chemie*, vol. lxxx., p. 44.



alcoholic crystals, similar to those used in experiments B, was dissolved in water; the solution was filtered to separate sulphur, and placed under a bell-glass, over strong sulphuric acid, to crystallise. The crystals thus obtained were re-dissolved in alcohol, the solution filtered to separate carbonate of potassium, then concentrated by evaporation, and made to crystallise. The crystals were quickly pressed between folds of filter-paper, and portions of them were weighed out for the analyses.

The crystals obtained directly from the aqueous solution of the sulphocyanide were contaminated to a considerable extent with carbonate of potassium; but, after they had been re-crystallised from alcohol, only traces of the carbonate were found upon them.

Stated in terms of per cents, the results may be tabulated as follows:—

		Found.		Theory.
		I.	II.	
A.	} Impure } crystals {	34.85	.. 33.91	32.90
B.		34.98	.. 34.33	
C.		32.45	.. —	
D.		32.85	.. 32.86	

I have applied the foregoing method, not only to sulphocyanide of potassium and to free sulphur, as above described, but also for estimating sulphur in vulcanised caoutchouc, and in several samples of anthracite and bituminous coal. It is easy to completely oxidise either of these substances by means of the mixed chlorate of potassium and nitric acid. Anthracite dissolves even more readily than bituminous coal, since, unlike the latter, it does not fuse to a single mass in the hot acid.

It is not improbable that, by a slight variation of the foregoing process, it may be found practicable to determine the carbon of an organic compound at the same time as the sulphur. Thus, the oxidation might, perhaps, be effected in a flask, provided with a wide funnel-tube for the addition of the chlorate, and a delivery-tube through which the carbonic acid formed could be led into baryta-water or some other substance fit to absorb that gas. Upon this point, however, I have as yet made no experiments.

May, 1869.

#### Assay of Sulphur in Iron Pyrites. By A. H. PEARSON.

The proportion of sulphur in iron pyrites ("sulphure") may be readily and accurately estimated as follows:—Weigh out 1 grm. or less of the powdered ore, place the powder in a porcelain dish, together with a small quantity of chlorate of potassium, pour upon it some 50 c.c. of pure nitric acid of 39° B., and cover the mixture with an inverted glass funnel with bent stem. Set the dish upon a water-bath, and heat the water to boiling. From time to time throw crystals of chlorate of potassium into the hot acid. By adding rather large crystals of the chlorate at frequent intervals, it is easy to oxidise the whole of the sulphide in half an hour; but, since the solution obtained in that case is highly charged with saline matter, it will usually be found more advantageous to use less of the chlorate of potassium, and to allow a somewhat longer time for the process of oxidation.

When all the sulphur has been oxidised, rinse the funnel with water, and remove it from the dish. Evaporate the liquid to a small bulk, then add to it a little concentrated chlorhydric acid, and again evaporate to absolute dryness, in order to render silicic acid insoluble. Moisten the residue with concentrated chlorhydric acid, mix it with water, and filter to separate silicic acid and gangue.

To the filtrate from the silicic acid add a quantity of solid tartaric acid, about as large as that of the pyrites originally taken; heat the liquid almost to boiling, and add to it an excess of chloride of barium, to precipitate the sulphuric acid. After the sulphate of barium has been allowed to subside, wash it thoroughly by decanta-

tion, first with hot water, and afterward with a dilute solution of acetate of ammonium; the latter may be prepared at the moment of use, by mixing ammonia-water and acetic acid. The purpose of the acetate of ammonium is to dissolve any nitrate of barium which may adhere to the sulphate; that of the tartaric acid is to prevent the precipitation of iron compounds together with the sulphate of barium. In an experiment where 0.7 grm. of pyrites was oxidised with chlorate of potassium and nitric acid, and the filtrate from silica was acidulated with chlorhydric acid without the addition of tartaric acid, there was thrown down, on the addition of chloride of barium, a bright yellow precipitate, which became darker-coloured when the solution was boiled. It was not only found to be impossible to wash out the iron with which this precipitate was contaminated, but the consistency of the precipitate was such that it was a difficult matter even to wash away the saline liquor in which the precipitate was formed.

In another experiment, the attempt was made to remove the iron from the filtrate from silica, before adding the barium-salt to throw down the sulphuric acid; but in that case a considerable portion of the sulphuric acid was dragged down as sulphate of potassium by the iron precipitate, and so lost. The precipitation of the iron was effected, in this experiment, by adding an excess of ammonia-water to the acidulated filtrate from silica, and washing the precipitate for a long time by decantation with boiling water. To prove that the iron precipitate really retained sulphuric acid, a quantity of the precipitate was dried, ignited, and powdered, and the powder boiled with water. The clear liquid thus obtained was acidulated with chlorhydric acid, and tested with chloride of barium. An abundant precipitate of sulphate of barium was at once thrown down.

After the sulphur of the pyrites has been determined by precipitating it from a tartaric-acid solution, as above described, the iron might perhaps be estimated in the filtrate, by one of the new methods of titration with hyposulphite of sodium. I have made no experiments with the hyposulphite, but have failed completely in several attempts to determine the iron as a sulphide by precipitating with sulphide of sodium, as directed by Fresenius. I found it impossible to wash the sticky, slimy mass of sulphide of iron. It is not easy, on the other hand, to destroy the tartaric acid by igniting the dried filtrate from sulphate of barium in a muffle; for, on evaporating this solution, the saline matters with which it is charged continually creep over the edges of the dish.

November, 1868.

#### Assay of Copper Pyrites. By F. P. PEARSON.

The following method of treating copper pyrites has been found more advantageous than the ordinary process of oxidising the mineral with aqua regia, and subsequently evaporating the solution repeatedly with chlorhydric acid, or with sulphuric acid, to expel the last traces of nitric acid:—

Place a weighed quantity of the powdered mineral, together with some chlorate of potassium, in a porcelain dish. (Five grms. of a variety of pyrites containing about 18 per cent of copper was found to be enough for one analysis; and a quantity of chlorate of potassium equal to a small tea-spoonful was added to the ore). Invert a small glass funnel with bent stem in the dish above the pyrites, and pour upon the latter rather more ordinary strong nitric acid than would be sufficient to completely cover the powder. Place the dish upon a water-bath, and, from time to time, throw into it small quantities of chlorate of potassium. The doses of the chlorate must be repeated at frequent intervals, until free sulphur can no longer be seen in the dish. If need be, add nitric acid, also, from time to time, to replace that lost by evaporation.

As a general rule, it is safer and more convenient to heat the mixture on a water-bath than upon sand, though I find that the oxidation of sulphur can be effected



more easily and quickly when the mixture of nitric acid and chlorate is heated to actual boiling than at the temperature obtainable by means of a water-bath. When the last particles of sulphur have been destroyed, remove the inverted funnel from the dish, rinse it with water, and collect the rinsings in a beaker by themselves. Allow the liquid in the evaporating-dish to become cold, pour upon it a quantity of ordinary strong chlorhydric acid rather larger than the quantity of nitric acid taken at first, evaporate the mixed solution to dryness, and heat the dry residue to render silica insoluble, in case any silica be present.

Pour water upon the cold residue, and, without filtering the liquor, wash the contents of the dish into the beaker which contains the rinsings of the funnel. Heat the liquid in the beaker nearly to boiling, add to it about 25 c.c. of a strong aqueous solution of ferrous sulphate slightly acidulated with sulphuric acid, and keep the mixture at a temperature near boiling during four or five minutes, in order to destroy the small quantity of nitric acid which has escaped decomposition in spite of the evaporation with chlorhydric acid.

The ferrous salt seldom or never acts instantaneously, but the reducing-action proceeds rapidly and perfectly satisfactorily when once begun. If need be, add more of the ferrous solution, little by little, until the entire contents of the beaker become dark-coloured or almost black and no more gas is disengaged.

In order to be sure that all the nitric acid has been reduced, it is well enough, after the mixture of liquid and solution of ferrous sulphate has been duly heated, to place a drop of the mixture upon porcelain, and test it with ferricyanide of potassium. In general, however, the colouration of the liquor in the beaker, due to the formation of nitrous or hyponitric acid, will be a sufficient indication that the copperas has done its work. The nitrous fumes quickly disappear from the liquid at a subsequent stage of operations when metallic iron is immersed in the solution.

When enough of the ferrous sulphate has been added, filter the mixed solution into a wide beaker, precipitate the copper, in the metallic state, upon a sheet of iron in the usual way, and ignite the copper, in a porcelain crucible, in a current of hydrogen, before weighing it.

By means of the ferrous salt, the last traces of nitric acid may be got rid of far more quickly, conveniently, and certainly, than by the old system of evaporating the pyrites-solution with several successive portions of chlorhydric acid. By treating the pyrites with chlorate of potassium and nitric acid, it is easy to oxidise and dissolve every particle of the sulphur in the mineral, so that no portion of the latter can escape decomposition by becoming enveloped in free sulphur. When aqua regia is used, on the other hand, or a mixture of chlorate of potassium and chlorhydric acid, a certain proportion of sulphur almost invariably remains undissolved, and might easily enclose portions of the mineral, so as to protect them from the solvent action of the acids.

The method of oxidation above described can manifestly be employed with advantage for dissolving many other sulphuretted ores besides copper pyrites.

January, 1869.

*Estimation of Sulphur in Sulphide of Mercury.* By  
E. W. BOWDITCH.

In order to contrast the action of the mixed nitric acid and chlorate of potassium with that of the mixture of chlorhydric acid and chlorate of potassium ordinarily employed by chemists as an oxidising agent, a series of comparative experiments were made upon commercial vermillion.

Eight portions of the vermillion were operated upon, in succession, as follows:—In each instance, about 0.5 or 0.6 grm. of the vermillion was placed in a small glass flask, set in an inclined position upon a wire-gauze support above a lamp. A quantity of nitric acid of 39° B., or

of concentrated chlorhydric acid, as the case might be, was poured into the flask; a small quantity of chlorate of potassium was added, and the mixture heated. From time to time, small bits of chlorate of potassium were thrown into the flask, the contents of which were maintained near the boiling-point until all the sulphur, or as much of it as possible, had dissolved.

In every instance where nitric acid was employed, the vermillion was, in a short time, oxidised and dissolved so completely that no trace of free sulphur could be seen in the liquor. But, when chlorhydric acid was used to decompose the chlorate, there remained, invariably, floating upon the liquid, one or more yellow globules of undissolved sulphur, varying in size from that of a pin's head to a flax-seed. These floating globules could not be destroyed by any practicable amounts of the chlorate and acid; in fact, it may be said to be impossible to destroy such globules with these reagents.

Whenever chlorhydric acid was used, therefore, to decompose the vermillion, the solution obtained had to be filtered, to separate the free sulphur, before the sulphuric acid in the solution could be precipitated as sulphate of barium. The presence of free sulphur is objectionable, not only because time is lost in collecting, washing, drying, and weighing it, but also on account of its liability to enclose and conceal particles of the substance to be analysed, which would be dissolved by the acid if the latter were able to act upon them. The determination of sulphur may thus be rendered incorrect by weighing the undissolved substances with the sulphur.

When nitric acid was used with the chlorate, it happened sometimes, when the proportion of nitric acid was small, that a considerable quantity of saline matter crystallised in the flask; it was found, however, that enough water to re-dissolve this precipitate might be added to the mixture, without impairing to any material extent the oxidising power of the chlorate subsequently added. The acid liquor resulting from the action of nitric acid and chlorate of potassium upon the vermillion was evaporated to dryness on a water-bath, and the residue treated with strong chlorhydric acid, in order to destroy most of the nitric acid before proceeding to precipitate the sulphuric acid with chloride of barium. Before adding the chlorhydric acid to the residue, the latter must be allowed to become perfectly cold, lest the mixture froth violently, and portions of it be thrown out of the flask. After the acid has once been added, however, the mixture may be heated gently without risk of loss.

No matter whether chlorhydric or nitric acid is employed with the chlorate, the solution must at last be largely diluted with water before adding the chloride of barium.

In my experiments, nothing but hot water was employed to wash the sulphate of barium. Naturally enough; it was more difficult to wash, in this way, the precipitates obtained from solutions contaminated with nitric acid than those from the solutions which contained only chlorhydric acid; but, in spite of this disadvantage, and of the long time required to wash out the last traces of nitrate of barium, I have always found that a sulphur determination made by the nitric-acid process requires much less time for its completion than one made by the old way with chlorhydric acid.

In a final trial, made expressly for the purpose of testing this point, the precise times consumed in making each experiment were carefully noted. Two portions of the vermillion were weighed out into flasks, and treated, one with chlorhydric acid and chlorate of potassium, and the other with nitric acid and the chlorate. The portion treated with chlorhydric acid weighed 0.5695 grm., and the other 0.519 grm. The flask containing the sample treated with chlorhydric acid was taken from the fire a few minutes before the last traces of sulphur in the nitric-acid flask had been destroyed, and the separation of the undissolved sulphur was proceeded with as rapidly as possible; but, in the end, it was found that eleven hours



and three-quarters were required to complete the determination of sulphur in the portion of vermillion treated with chlorhydric acid, while the estimation of sulphur in the other portion, treated with nitric acid, was finished in nine and a half hours. 14.32 per cent of sulphur was found in the portion treated with nitric acid, and 14.25 per cent in the portion treated with chlorhydric acid, instead the 13.79 per cent required by theory.

February, 1868.

*Estimation of Chromium as Chromate of Barium.* By  
A. H. PEARSON.

As Professor Storer has shown,\* chromic oxide is quickly changed to chromic acid when boiled with a mixture of concentrated nitric acid and chlorate of potassium. All the chromium in  $\frac{1}{2}$  gm. of hydrate of chromium, or of any of the ordinary chrome salts, can in this way be converted into chromic acid in a few moments; and even compounds as refractory as chrome-iron ore, or oxide of chromium which has been strongly ignited, can be oxidised in less time than would be required to complete their oxidation by the process of fusion ordinarily employed.

As will appear from the experiments which follow, the chromic acid thus formed in the wet way can be readily and accurately estimated in the form of chromate of barium, if care be taken to wash the precipitated chromate with acetate of ammonium, or some other saline solution in which chromate of barium is insoluble.

1. A quantity of anhydrous chromic oxide was prepared, by heating bichromate of potassium with an excess of strong chlorhydric acid until chlorine ceased to be evolved, saturating the acid liquor with ammonia-water, washing and drying the precipitated hydrate, and finally igniting it intensely in a platinum crucible over a blast-lamp.

0.102 gm. of this anhydrous oxide was placed in an evaporating-dish, together with a quantity of nitric acid and some chlorate of potassium, and covered with an inverted funnel with a bent stem. The acid was heated, and fragments of chlorate of potassium were added to it from time to time, until the chromic oxide had completely disappeared. This result was attained in the course of half an hour.

The acid solution was diluted with water, then neutralised with ammonia, and the ammoniacal solution in its turn treated with enough acetic acid to make it slightly acid. After the acidulated solution has become cold, a solution of chloride of barium was added to it in slight excess, and the mixture was left at rest for ten or twelve hours. The precipitated chromate of barium was washed by decantation with a cold solution of acetate of ammonium, then collected on a filter, rinsed with water, dried, heated in a crucible to expel the last traces of water and of the ammonium-salt, and weighed.

The amount of chromate of barium obtained in this experiment was equal to 0.336 gm., which is equivalent to 68.31 per cent of chromium, instead of 68.62 per cent as required by theory.

The precipitate of chromate of barium must be allowed to stand for some time before filtering, lest it pass through the pores of the filter, and render the filtrate cloudy.

The acetate of ammonium employed for washing serves to dissolve any nitrate of barium or chloride of barium which may have been precipitated with the chromate; it has the further advantage of dissolving less of the chromate of barium than pure water would.

2. A quantity of hydrate of chromium, precipitated from a solution of reduced bichromate of potassium, as in the previous experiment, was dried at 115°, and the proportion of water retained by the dried hydrate was determined once for all by ignition.

0.11 gm. of this dried hydrate, equal to 0.0688 of the anhydrous oxide, was then treated with nitric acid and chlorate of potassium, as in experiment 1. It was found that the oxidation was completed as soon as the acid

became hot enough to decompose the chlorate. Less than five minutes were sufficient, in this instance, for the complete conversion of the chromium to chromic acid.

The chromate of barium obtained weighed 0.2286 gm., equivalent to 68.65 per cent of chromium in the oxide taken, instead of the theoretical 68.62 per cent.

3. 0.113 gm. of the dried hydrate, containing 0.0707 gm. of the anhydrous oxide of chromium, was mixed with a quantity of nitrate of magnesium (prepared by dissolving carbonate of magnesium in nitric acid), before the treatment with nitric acid and chlorate of potassium. 0.2346 gm. of chromate of barium was obtained; in other words, 68.60 per cent of chromium, instead of the 68.62 per cent required by theory.

4. 0.114 gm. of the dried hydrate of chromium, containing 0.0713 gm. of the anhydrous oxide, was mixed with nitrate of aluminum (prepared by dissolving hydrate of aluminum in nitric acid), before the treatment with chlorate of potassium. 0.2356 gm. of chromate of barium was obtained; that is to say, 68.31 per cent of chromium, instead of 68.62 per cent.

5. A small quantity of chrome-iron ore was ground to very fine powder, and treated, in a dish, with nitric acid and chlorate of potassium, as above described. At the end of half an hour, that portion of the ore which still remained undissolved was washed with water, dried, fused with a mixture of carbonate of sodium and nitrate of potassium, and the fused mass boiled with water; but the solution thus obtained gave no reaction for chromium when tested for that substance.

It appears, from the foregoing experiments, that chromium can be readily estimated in this way in presence of aluminum and magnesium. The process can doubtless be employed also for separating chromium from iron, cobalt, nickel, and zinc. As a matter of course, special care must always be taken to employ reagents which are absolutely free from any contamination of sulphuric acid.

April, 1869.

*On the Use of Chromate of Barium in Quantitative Analysis.*  
By R. H. RICHARDS.

A sample of pure bichromate of potassium, examined simultaneously by three of the students in the Institute's laboratory, for the purpose of determining the percentage of chromium by precipitating that element in the form of chromate of barium, gave the following discordant results (the method of analysis was similar to that described below):—

Name of experimenter.	Grms. of $K_2O, 2CrO_3$ taken.	Grms. of $BaO, CrO_3$ found.	Percentage of chromium.	
			Found.	Theory.
N. F. Merrill	.. 0.516	.. 0.8640	.. 34.67	.. 35.56
F. P. Pearson	.. 0.500	.. 0.8788	.. 36.38	.. „
C. E. Avery	.. —	.. —	.. 36.31	.. „
„	.. —	.. —	.. 36.24	.. „

At the suggestion of Professor Storer, I have examined other portions of the same sample of bichromate of potassium, with the view of discovering, if possible, the sources of error which vitiated the foregoing analyses.

A quantity of the bichromate was heated until it fused, the cold mass powdered and several portions of it, weighing from one to two grms. each, were taken for analysis. Each of the weighed quantities of bichromate was dissolved in distilled water; the solution was heated nearly to boiling, and a lump of acetate of sodium twice the volume of the bichromate of potassium taken was thrown into the hot liquor. Acetic acid was then added to strongly acid reaction, and afterwards a solution of chloride of barium, with occasional stirring, until no more precipitate was formed on the further addition of chloride of barium and until the supernatant fluid became absolutely colourless. It is easy to hit this point in a hot solution but not so easy when the liquid is cold.

After the precipitate had been allowed to stand for some time, the clear liquid above it was decanted into a

\* *Proceedings of the American Academy*, 1859, vol. iv., p. 342.



filter. The precipitate was then washed with cold water, first by decantation in the beaker and afterwards upon the filter. The filtrate proper, that is to say, the clear liquor decanted from the precipitate, was in every instance colourless. It gave a white residue when evaporated on platinum foil and no precipitate when tested with acetate of lead. But all the subsequent liquors obtained by decantation and washing came through the filter distinctly yellow-coloured. They gave yellow residues when evaporated upon foil and bright yellow precipitates when tested with acetate of lead. It was, consequently, no easy matter to determine when to stop washing. The precipitates were, in fact, put aside to dry as soon as there was any reason to suppose that the saline mother-liquor had all been washed out from them.

In the second of the following experiments the chromate of barium was weighed upon a tared filter, as was the case also in the experiments cited above, but in Nos. 1, 3, and 4, the dry precipitate was ignited gently in a porcelain crucible before weighing.

No. of the experiment.	Grms. of $\text{K}_2\text{O}, 2\text{CrO}_3$ taken.	Grms. of $\text{BaO}, \text{CrO}_3$ found.	Percentage of chromium found.	Theory.
1.	1.0095	1.7301	35.47	35.56
2.	1.0175	1.8444	37.53	
3.	1.5456	2.7541	37.74	
4.	1.5020	2.5696	35.49	

Experiments 3 and 4 were carried out side by side, and every effort made to treat them exactly alike.

From the appearance and behaviour of the wash-water, as above described, it appears that chromate of barium is somewhat soluble in pure water, but is insoluble in tolerably strong saline solutions, even in the presence of acetic acid. This observation agrees in the main with a statement\* in Professor Storer's "Dictionary of Solubilities" to the effect that "chromate of baryta is very slightly soluble in water, and even insoluble when other salts are present in solution."

On the other hand, the excess of precipitate found in experiments 2 and 3, would go to show that chloride of barium is liable to be dragged down by chromate of barium in the same way that it is apt to go down with sulphate of barium. It would appear, therefore, that some saline solution, competent to dissolve chloride and nitrate of barium, should be used instead of water for washing chromate of barium. [P.S.—In accordance with this view Mr. A. H. Pearson has recently employed a solution of acetate of ammonium, with the best results, for washing both the chromate and the sulphate of barium.]—*American Journal of Science*, vol. xlviii., No. 143.

## PROCEEDINGS OF SOCIETIES.

### CHEMICAL SOCIETY.

April 21st, 1870.

Professor WILLIAMSON, F.R.S., President, in the Chair.

T. PATCHETT was elected a Fellow.

Professor ROSCOE, F.R.S., delivered a lecture "On Vanadium."

This metal was discovered in 1830, by Sefström, in the celebrated Swedish bar-iron made from the Taberg ore. Sefström ascertained some of the most peculiar characters of this substance, proved it to be a new element, and prepared some of its compounds in the pure state. The reactions by which vanadium can be separated and distin-

guished from all the other elements are:—(1) The formation of a soluble sodium vanadate when the vanadium compounds are fused with sodium carbonate; (2) the formation of an insoluble ammonium vanadate when sal ammoniac is added to the solution of a soluble vanadate; (3) the production of a splendid blue solution when this ammonium salt, dissolved in hydrochloric acid, is warmed with reducing agents, such as oxalic acid.

Sefström, not having leisure to prosecute the full examination of the properties of the new metal, handed over his preparations to Berzelius; and it is to the investigations of the great Swede that we owe almost all our acquaintance with the chemistry of vanadium.

Since Berzelius's time, vanadium has been discovered in many minerals, of which a lead ore containing lead vanadate, and called by the mineralogists, vanadinite, is the most important.

In 1865, Professor Roscoe came into possession of a plentiful source of vanadium, in a by-product obtained in the preparation of cobalt from the copper-bearing beds of the lower Keuper Sandstone of the Trias, at Alderley Edge, in Cheshire. Following, in the main, the process of preparation adopted by Sefström, Professor Roscoe obtained, from the above-mentioned source, several pounds of pure ammonium vanadate, from which all the other compounds of vanadium can be prepared.

What, now, were the conclusions to which Berzelius arrived, from his experiments concerning the constitution of the vanadium compounds? He assigned to its three oxides the formulæ  $\text{VO}$ ,  $\text{VO}_2$ , and  $\text{VO}_3$ , whilst the chloride was represented by  $\text{VCl}_3$ . The atomic weight of the metal he found to be  $\text{V} = 68.5$ .

Some years afterwards, Rammelsberg observed that vanadinite, a double salt of lead-vanadate and lead chloride, is isomorphous with apatite and with mimitesite, the former containing phosphoric, the latter arsenic acid. This crystallographic analogy would lead us to conclude that the oxide of vanadium in the vanadinite has the formula  $\text{V}_2\text{O}_5$ , agreeing with the corresponding oxides of phosphorus and arsenic,  $\text{P}_2\text{O}_5$  and  $\text{As}_2\text{O}_5$ ; but the unyielding chemical facts of Berzelius compel us to view the oxide in question as  $\text{VO}_3$ . It was, then, evident that here was either an exception to the law of isomorphism, or else Berzelius's views were erroneous.

Professor Roscoe, in order to endeavour to clear up this question, had carefully repeated Berzelius's experiments, and he found them confirmed in every particular; but, having pursued the subject further than Berzelius, he had succeeded in obtaining the key to the enigma presented by the above anomalous crystallographic relations.

The lecturer has proved that the substance supposed by Berzelius to be vanadium, is not the metal, but an oxide, and that the true atomic weight of the metal is 51.3. The vanadic acid,  $\text{VO}_3$ , of Berzelius, hence, becomes  $\text{V}_2\text{O}_5$ , corresponding to  $\text{P}_2\text{O}_5$  and  $\text{As}_2\text{O}_5$ ; and the above-mentioned isomorphism is fully explained. The suboxide of Berzelius is a tri-oxide,  $\text{V}_2\text{O}_3$ ; whilst the terchloride ( $\text{VCl}_3$ ) of Berzelius is an oxychloride,  $\text{VOCl}_3$ , corresponding to oxychloride of phosphorus,  $\text{POCl}_3$ .

Professor Roscoe has succeeded in obtaining bromine and iodine compounds of vanadium, and also various metallic vanadates. He went on with his lecture by pointing out that the characters of the vanadates bear out the analogy of the vanadic acid with the highest oxides of phosphorus and arsenic; and stated, in conclusion, that vanadium, hitherto standing in no definite relation to other elements, must now be regarded as a member of the well-known triad class of elementary substances, comprising nitrogen, phosphorus, boron, arsenic, antimony, and bismuth.

The PRESIDENT, in proposing a vote of thanks to the lecturer, called attention to the great service Professor Roscoe had rendered to chemical science by his successful investigation of vanadium.

After the delivery of this lecture, Professor HOFMANN, from Berlin, favoured the Society with a few observations

\* Cited from Dumas's *Traité de Chimie appliquée aux Arts*.



on an organic body he had obtained by treating sulphurea with silver oxide. This substance,  $\text{CH}_2\text{N}_2$ , is distinguished by its great tendency to polymerise.

Dr. Hofmann further communicated that a compound isomeric with chloral had recently been discovered by two Berlin chemists. It differs from ordinary chloral by its much higher boiling point.

# MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, April 5th, 1870.

J. P. JOULE, D.C.L., LL.D., F.R.S., &c., President, in the Chair.

"Description of a New Anemometer." By PETER HART.

On the appearance of Mr. Fletcher's admirable paper "On the Speed of Air in Flues," it appeared to me that an anemometer more easily read and less costly than his was desirable. With this view I devised the present one, which may be broadly described as a common U-tube gauge laid in a sloping position, so as to form the hypotenuse of a right-angled triangle, the perpendicular of which is the true reading.

The following description will explain its construction:—

It consists first of a base board furnished with levels and levelling screws; to this is hinged the board carrying the U-tube, which may be called the sloping base; on this sloping base is secured the U-tube furnished with a scale and vernier capable of being read to the 1-100th inch. By means of a screw passing through the sloping base, and resting on the lower base board, the former can be made to assume any angle with the latter, the angle being determined by a quadrant fixed to the lower base board.

By this arrangement a very great degree of accuracy in reading is obtainable. Thus, in the present instrument, the quadrant is set 5 inches distant from the hinge, and when set at 0.5 inches on the quadrant, it gives a rise of 1 in 10; consequently, the ether in the U-tube has to move 10 inches for 1 inch of vertical rise. The rule for getting the result may be stated thus:—

Divide the space between the hinge and the quadrant by the quadrant elevation, now divide the movement of the ether by the quotient, and the product is the true vertical movement *nearly*.

Thus, suppose, as before, the quadrant elevation to be 0.5 inch, the distance from hinge to quadrant 5.0 inches, and the ether's movement 1 inch: then—

$$\frac{5}{0.5} = 10 \text{ and } \frac{1.0}{10} = 0.1 \text{ inch.}$$

Or again, the quadrant elevation being 0.2 inch, the other quantities the same: then—

$$\frac{5}{0.2} = 25 \text{ and } \frac{1.0}{25} = 0.04 \text{ inch.}$$

These results, though not absolutely correct, will, in most cases, be sufficiently so; but where rigid accuracy must be had, the following table will supply the means:—

Quadrant Elevation in 10 inches.	Hypotenuse.	Quadrant Elevation in 10 inches.	Hypotenuse.
0.1 inch ..	10.00049	1.1 inch ..	10.06035
0.2 ,, ..	10.00199	1.2 ,, ..	10.07174
0.3 ,, ..	10.00449	1.3 ,, ..	10.08414
0.4 ,, ..	10.00799	1.4 ,, ..	10.09752
0.5 ,, ..	10.01248	1.5 ,, ..	10.11187
0.6 ,, ..	10.01799	1.6 ,, ..	10.12714
0.7 ,, ..	10.02447	1.7 ,, ..	10.14347
0.8 ,, ..	10.03199	1.8 ,, ..	10.16061
0.9 ,, ..	10.04049	1.9 ,, ..	10.17888
1.0 ,, ..	10.04987	2.0 ,, ..	10.19803

First find what aliquot part of 10 the quadrant elevation was; find this in the quadrant column. Opposite this will be found a number which is the hypotenuse. Then, as this number is to 10, so is the number obtained by the first method to the true number.

Thus, to take the first illustration, of 0.5 in 5 inches: this is equal to 1 in 10. The hypotenuse of 1 in 10 (see table) = 10.04987. Now, 0.1 inch was the result obtained. Then, as 10.04987 : 10 :: 0.1 : 0.09955, which is the true vertical rise.

I had no little difficulty in my first efforts to restrain the excessive oscillations of the ether column, owing to the almost constant fluctuations of draught in flues. To obviate this the tube was choked to a narrower bore at the bend. This proving insufficient, I overcame the defect by the very simple means of inserting a piece of sponge at this part.

It is, perhaps, needless to add that it is necessary to employ Mr. Fletcher's tubes for insertion into the flue, and also his tables.

## CORRESPONDENCE.

### MANUFACTURE OF SULPHURIC ACID.

To the Editor of the Chemical News.

SIR,—I have been much interested in the discussion on the above subject, which has appeared in your journal, but I think there is some want of precision in some of the statements that have been made.

In the CHEMICAL NEWS, vol. xxi., p. 106, there appeared a translated extract from a paper of Mr. Hofmann's containing the statement:—"By this contrivance, it is possible to manufacture sulphuric acid with a consumption of only 1 lb. of nitric acid for 100 lbs. of sulphur burnt." My attention was arrested by this statement, but on enquiry I was informed by an excellent German chemist who had access to the original paper, that Dr. Hofmann merely claimed to manufacture an equal product of sulphuric acid with *one per cent less nitric acid than had formerly been in general use*. This would change the entire aspect of the question, for I know very well that British manufacturers profess to procure an adequate return (say, from 286—294  $\text{H}_2\text{SO}_4$ , specific gravity 1.846, from 100 of S.) of acid, while they vary in the percentage of nitrate of soda, which they consume in the process from 2.5 up to 8 or 9. The quantity of nitrate used very much depends on the chamber room, regularity of working, supply of steam and air, &c., and on this account I am strongly of opinion that, valuable as Dr. Hofmann's suggestion may be (and I intend to give it a fair trial, extending over many weeks unless deterred by its decided failure), I cannot regard it as more than a small item in a very complex question.

From the few data given by Mr. Spence, we may arrive at an approximation to the results obtained by him; and, if my calculations are correct, I think it will appear that Mr. Spence has not yet attained all that he might wish for. Mr. Spence tells us that he requires about 100 tons of acid, sp. gr. 1.845, per week, and that, in making this quantity of acid, he expended 4 tons 2 cwts. of nitrate of soda. Now, if we assume that the production of acid is adequate (294 from 100 S.), then Mr. Spence was using, before his late change in working, 12.06 to 100 of sulphur. If, on the other hand, we assume that Mr. Spence, in common with many manufacturers, expends only 8 per cent of nitrate in the case of sulphur, or 4.5 per cent to Mason's ore, then his kilns should consume 51 tons of sulphur, producing 145—150 tons of acid, sp. gr. 1.845, or, if he burn pyrites, 91 tons of Mason's ore, giving 125 tons of acid. The above data are founded on the quantities quoted by Mr. Spence, and are as precise as the absence of the absolute weights used and obtained



will permit; but they demonstrate that it is perfectly possible to obtain an improvement, and that a very considerable one, if my calculations respecting Mr. Spence's working be correct. Every manufacturer of oil of vitriol will bear out my experience, which is this—that the economical production of vitriol is a problem which every man must solve in a great part for himself, and that it depends on a variety of conditions, not exactly the same in many instances; but they may be classed into the chemical, the physical, the practical, and the commercial. The first and second of these are of paramount importance, and have not been sufficiently attended to, or all might arrive at a perfection almost complete; the latter involve the consideration of perfection of apparatus, skilled attention to working, and the varying conditions which regulate supply according to price and demand. In conclusion, I may say that I agree with Mr. Gibbins that there is much difficulty in making acid which has absorbed nitrous compounds give them up completely, as I have detected them in the acid, although in much diminished quantity, after dilution, agitation, and boiling.

I fear I have trespassed already too much on your valuable space, so that I must conclude.—I am, &c.,

DAVID BASIL HEWETT, B.A., T.C.D.

Manchester, April 25th, 1870.

## MISCELLANEOUS.

**Death of Dr. Magnus, of Berlin.**—We learn with great regret that the celebrated physicist, Dr. Heinrich Gustav Magnus, of Berlin, died there on the 4th inst; the deceased was born at Berlin on the 2nd of May, 1802, and took the degree of Ph.D. at Berlin University in 1827, his inaugural dissertation written in Latin bearing title "De Tellurio." In 1834 he was appointed Extraordinary Professor of Natural Philosophy at Berlin University, and in 1845 became Ordinary Professor for the same subject. The deceased largely contributed to extend our knowledge of physical sciences, but owing to the great mass of his various contributions, it is quite impossible to give here even a brief outline of his labours. The deceased was a member of several scientific societies and institutions, and carried on a regular correspondence with the foremost scientific men in the civilised world.

**Description of Browning's Automatic Spectroscope.**—This instrument is furnished with a battery of six equilateral prisms of dense flint glass; all the prisms are joined together like a chain by their respective corners, the bases being in this manner linked together. This chain of prisms is then bent round so as to form a circle with the apices outwards; the centre of the base of each prism is attached to a radial rod. All these rods pass through a common centre. The prism nearest the collimator, *i.e.*, the first prism of the train, is a fixture. The movement of the other prisms is then in the proportion of 1, 2, 3, 4, and 5, the last or 6th prism moving five times the amount of the second. All these motions are communicated by the simple revolution of the micrometer screw, which is used for measuring the position of the lines in the spectrum, and the amount of motion of each, and of the telescope, is so arranged that the prisms are automatically adjusted to the minimum angle of deviation for the ray under examination. It is easy to test the efficiency of the instrument in this respect. On taking the lens out of the eye-piece of the telescope, the whole field of view is found to be filled with the light of the colour of that portion of the spectrum which the observer wishes to examine; while in a spectroscope of the usual construction, at the extreme ends of the spectrum, just where the light is most required, only a lens-shaped line of light would be found in the field of view. As a consequence of this peculiarity, the violet and deep red ends of the spectrum are greatly elongated,

or rather much more of them can be seen than in an ordinary spectroscope, and the H lines, which are generally seen only with difficulty, come out in a marked manner.

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

*Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

*Comptes Rendus des Séances de l'Académie des Sciences*, April 18, 1870.

The papers and memoirs relating to chemistry or collateral sciences in this number are:—

**Clinorhombic Form of the Red Oxide of Mercury.**—M. des Cloizeaux.—The author describes, at great length, the crystallographical shape of this oxide as obtained by a peculiar, but not detailed process, and incidentally mentions, that the *melanconise*, from Cornwall (a native oxide of copper), is, according to Mr. Maskelyne, the only other metallic oxide belonging to the clinorhombic system.

**Second Notice relating to the Specific Heat of Water when near its Maximum Specific Gravity.**—G. A. Hirn.

**Experimental Researches on Gold and its Compounds.**—J. P. Prat.—The main features of this lengthy paper are the following:—In order to obtain the best possible solution of gold, the two constituents of the aqua regia, nitro-hydrochloric acid, should be each diluted with their own bulk of water previous to being mixed together; the metal having been dissolved, of course heat is to be applied. The previously quite cooled liquid is neutralised with bicarbonate of potassa; and, next, oxalic acid is added, which causes the reduction of the gold to the metallic state, but in the shape of a very finely-divided powder, which, however, agglutinates by applying heat, so as to become a spongy mass, which may readily be kneaded into shape by the fingers. The author describes the combinations of gold with oxygen and with chlorine—to wit, an intermediate, or olive-coloured oxide,  $\text{Au}_2\text{O}_2$ ; a binoxide,  $\text{AuO}_2$ ; a protochloride, sesquichloride, and perchloride (the latter a volatile substance). Among the salient points resulting from the author's researches, the most remarkable is that gold may be directly oxidised and salified by some of the oxacids, and that, in many instances, gold behaves with reagents as other metals do.

**Spectrum Analysis of a Sun's Spot.**—G. Rayet.

**Variations of the Index of Refraction of Water, as Dependent upon its Temperature.**—M. Croullebois.

**Assay of Silver which contains Mercury.**—H. Debray.—This paper, especially interesting to those who have daily to make assays of silver by the moist way, or Gay Lussac's process, is not well suited for abstraction; and it, moreover, appears that the author is unaware of the fact that, some fifteen years ago, Prof. G. J. Mulder pointed out what is here brought forward as something quite new, in his work (published in the Dutch language) "On the Assay of Silver by the Moist Way." The mercury here alluded to is, of course, a comparatively very small quantity, found in metallic silver occasionally.

**Iodhydrates and Chlorhydrates of Monobromated Ethylen and Propylen.**—E. Reboul.

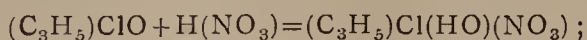
**New Researches on Black Phosphorus.**—M. Blondlot.—The author states that, after having given away all he had of black phosphorus prepared by him in 1866 by Thenard's method, he set to work, some short time ago, to prepare a fresh quantity, but did not succeed until he added some mercury and heated the metal along with it. His researches on the nature of the *pigmentum*, as he calls the black phosphorus, prove that it does not contain even the least trace of mercury; and he concludes that it merely acts catalytically in this instance.

**Dextrine Insoluble in Water.**—M. Musculus.—It appears, from this lengthy paper, that dextrine may be obtained in a state insoluble in water by acting upon starch with either very strong acetic (glacial) acid; or, also, by modifying the action of sulphuric acid and water upon starch. The dextrine separates in the shape of rather bulky granules, which increase in size (they are, however, very small, because their diameter varies from 0.001 to 0.030 m.m.) according to the length of time they are left in the mother liquor, wherein they are formed; these granules are insoluble in cold water, but are suddenly dissolved when they are placed in water at 50°, and they then remain soluble.

**Chloronitric and Bromonitric Ethers of Glycerine.**—L. Henry.—The author first observes that the only nitric acid compound, as yet known, of glycerine, is the trinitrine of glycerine, a substance of too great notoriety under the misnomer of nitroglycerine. The author next describes, at very great length, the preparation and properties of—



Monochloro-dinitrine,  $(C_3H_5)(NO_3)_2Cl$ ; monochloro-mononitroglycerine—



monochloro-dinitroglycerine—



dichloro-mononitrine,  $(C_3H_5)Cl_2(NO_3)$ , a colourless liquid, almost insoluble in water, but soluble in alcohol and ether (sp. gr. at  $10^\circ$ , 1.465; monochloro-dinitrine,  $(C_3H_5)Cl(NO_3)_2$ , also a liquid of great density (viz., 1.5112 at  $9^\circ$ ).

**Direct Combination of Allylic Compounds with Chloride of Iodine and Hypochlorous Acid.**—L. Henry.

**Formation of Urea by the Action of Permanganate of Potassa on Albumenoid Substances.**—A. Béchamp.—The contents of this valuable paper may be summarised thus:—The elimination of urea in the animal body is the result of the oxidation of the albuminous compounds of the blood; and the author proves this by operating with permanganate upon pure albuminous substances, freed purposely from fatty matters and sugar, and kept in solution by means of a weak alkali.

**Aurora Borealis seen on the 5th of April last.**—L. Sonrel.—From this lengthy paper, we learn that this phenomenon, already alluded to by us last week, was visible over nearly all Europe, and that, wherever it was visible, the magnetic instruments were violently agitated. The author enters into a great many details on this subject, among which the most remarkable is that the Aurora was accompanied, or preceded, for a brief period, by a very disagreeable smell (the quality thereof is not specified), very perceptible, as well at Dinkelsbühl (Bavaria), as at Paris. In high northern latitudes, this phenomenon is often accompanied by a peculiar, somewhat sulphurous, and rather oppressive, smell.

**Poisonous Property of some of the Products of the Phenic Acid Series.**—P. Guyot.—The accidents caused by such products as coralline, azuline, &c., depend simply upon the mode of preparation employed; for, if excess of aniline or phenol is present, the material becomes poisonous.

**Earthquakes and Volcanic Explosions observed in the Netherlands' Indies from the beginning of the 16th century to the present time.**—L. de Backer.—This paper, or, rather, chronological enumeration of volcanic eruptions, earthquakes, and other volcanic phenomena, vomiting of mud and boiling water from a series of volcanoes in the Indian Archipelago, begins with the year 1506, and comes down to our days. No portion of the inhabited globe, during its present geological age, has been the scene of such great and continuous volcanic action as that beautiful portion of the globe here alluded to. This paper is a very valuable contribution to our knowledge of the effects of volcanic action in various ways. The number of earthquakes and eruptions noticed (viz., by Europeans, and recorded by them) from 1506 to 1847 alone amounts to 141; and there is, as observed by Dr. Junghun, very great reason to suppose that this number is 50 per cent too low.

#### *The American Journal of Science and Arts, March, 1870.*

This number contains the following original papers relating to chemistry and collateral sciences:—

**Photometric Experiments.**—Part I.: On a Simple Form of Photometer for Determining the Amount of Light Reflected by Metallic Surfaces at Different Incidences.—Ogden N. Rood.—Illustrated with woodcuts, without which an abstract would not be understood.

**Contributions to the Chemistry of Copper.**—T. Sterry Hunt.—Reserved for full reproduction.

**Silver Mines of Santa Eulalia, State of Chihuahua, Mexico.**—James P. Kimball.—A very interesting contribution to the history of silver mining; also bearing testimony to the enormous mineral wealth of Mexico.

**Machinery and Processes of the Industrial Arts, and Apparatus of the Exact Sciences.**—F. A. P. Barnard.—This is the report made by the author, as U. S. Commissioner to the last Paris Industrial Exhibition, on this subject.

**Norite or Labradorite Rock.**—T. Sterry Hunt.

**Cause of the Colour of the Water of Lake Lemán, Geneva, Switzerland.**—A. A. Hayes.—The author's concluding words on this often discussed and investigated subject are—"The negative results of chemical analysis, and the sufficiency of the reflected and refracted light of the sky which is over the water of Lake Lemán, led me to the conclusion that the cause of the colour is found in the peculiar hue of the sky, so transmitted to the eye by a colourless water."

**On the Potassio-Cobaltic Nitrite known as Fisher's Salt, and some Analogous and Related Compounds.**—S. P. Sadtler.—This very lengthy treatise is filled with a large number of formulæ. The author's chief conclusion is that the salt alluded to is essentially a compound having the formula  $Co_2NO_2 + 6(KNO) + aq$ .

**Meteors of November, 1869.**—H. A. Newton.

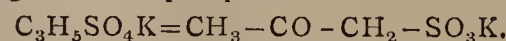
#### *Zeitschrift für Chemie von Beilstein, No. 6, 1870.*

This number contains the following original papers:—

**On Tetramethyl-Benzol.**—P. Jannasch and R. Fittig.—After having entered, at some length, into speculative discussions referring

to the possibility of the substitution of more than three atoms of hydrogen in benzol, the authors describe, at great length, the process of preparation whereby they obtained a tetramethyl-benzol,  $C_{10}H_{14} = C_6H_2(CH_3)_4$ , which substance they have called *durol*, because there may exist several modifications of tetramethyl-benzol. Durool is the only hydrocarbon yet known belonging to the benzol series, which is a solid body at the ordinary temperature of the air. It is crystalline; readily soluble in alcohol, ether, and benzol; fuses about  $80^\circ$ , and boils at between  $189^\circ$  and  $191^\circ$ ; is specifically lighter than water; and, when burning, exhibits a very luminous flame. Dinitro-durool,  $C_{10}H_{12}(NO_2)_2 = C_6(NO_2)_2(CH_3)_4$ , is obtained by the action of very strong nitric acid upon durool. Dinitrodurool is also a solid, crystalline body, readily soluble in ether, less readily in benzol and in boiling alcohol, fuses at  $205^\circ$ , and is sublimed without decomposition. Dibromo-durool,  $C_{10}H_{12}Br_2 = C_6Br_2(CH_3)_4$ , a solid substance, very difficultly soluble in alcohol, fusing at  $199^\circ$ , and sublimable without decomposition.

**Aceton-Sulpho Acid.**—Dr. Bender.—The author prepared this substance from dichloroacetone and a solution of neutral sulphite of potassa, yielding aceton-sulpho-potassa—



By treating this salt with dilute sulphuric acid, no sulphurous, nor sulphuric acid, is given off; but the aceton-sulpho acid was not obtained in free state.

**Some of the Derivatives of the Toluol Series.**—E. Wroblevsky.—This paper might almost be compared to a catalogue. The author enumerates, first, isomeric monochlor-methyl-phenetols, viz.— $\alpha$  methylchlor-phenetol, a fluid boiling at about  $220^\circ$  (sp. gr. at  $19.5^\circ$ , 1.127);  $\beta$  methylchlor-phenetol, also a fluid boiling at  $220^\circ$  (sp. gr.,  $18^\circ$ ). Secondly, isomeric chlor-iod-toluols, viz.— $\alpha$   $C_7H_6ClI$ , a fluid boiling at about  $242^\circ$  (sp. gr., at  $17^\circ$ , 1.716), and is not solidified at  $-14^\circ$ ;  $\beta$   $C_7H_6ClI$ , again a fluid boiling at  $240^\circ$  (sp. gr. at  $19^\circ$ , 1.770). Thirdly—Para-iod-orthobrom-toluol,  $C_7H_6BrI$ ; dichlorotoluidine,  $C_6H_3Cl_2.CH_3$ ; nitro-dichlorotoluol, a fluid exhibiting the smell of nitrobenzol, soluble in alcohol and ether, and boiling at  $274^\circ$  (sp. gr. at  $17^\circ$ , 1.455).

**Isomeric Nitro-Bromotoluols and Bromotoluidine.**—E. Wroblevsky.—This paper is chiefly a critical review of the labours of a great many chemists who have been engaged in researches on this subject, and, like the foregoing paper, is a catalogue of substances.

**On Diethglyoxylic Ether.**—A. Schreiber.—Of the substance here alluded to, the preparation and derivation are described at great length. Diethglyoxylic ether,  $CH(C_2H_5O)_2COOC_2H_5$ , is a very clear, colourless, strongly-refrangible liquid (sp. gr. at  $18^\circ$ , 0.994), miscible with alcohol and ether in every proportion; diethglyoxylic acid amide,  $CH(C_2H_5O)_2CONH_2$ , is a solid substance crystalline, fusing at  $76.5^\circ$ , and readily soluble in water and alcohol.

**Conditions of the Formation of the Mono-Sulpho Acids of Naphthaline.**—V. Merz and W. Weith.—This paper is not well suited for useful abstraction.

#### *Revue Hebdomadaire de Chimie, April 7, 1870.*

**Preservation of Beet-Root Leaves for Fodder for Cattle.**—

M. Mehay.—Under this title, the author describes, at great length, a method of preservation of the leaves alluded to, but also applicable to other leaves of a similar nature, and perhaps to grass, which method consists mainly in the following process:—Into a vessel of some 2 hectolitres' capacity (about 45 gallons) are poured from 2 to 3 decilitres (each decilitre is equal to 0.176 pint, or 6.102 cubic inches) of hydrochloric acid, sp. gr. 1.18 (that is to say, an acid of 38 per cent of  $ClH$  at  $15.5^\circ$ ); and next there is added to this acid a large quantity (how much is not stated) of water. The fluid is thoroughly mixed, by means of a wooden spatula; and next, 50 kilos. of the leaves, yet attached to the crown part of the root, which is cut off, are placed in this liquid and thoroughly immersed therein. This having been done, the entire mass is heated to the boiling-point, and kept boiling for 10 or 15 minutes; the leaves are taken from the cauldron, by means of wooden forks, and placed on hurdles, so as to admit of the surplus liquid draining off, after which the leaves are fit to be preserved in a manner similar to that in which potatoes, turnips, and the like are kept, by being placed in pits covered inside with straw, and next covered over with the soil of the garden or farm ground. We cannot enter more fully into this subject, which is, however, deserving the attention of agriculturists. The author states that the acid combines with the alkaline salts of the leaves and thus forms chlorides of sodium and potassium; the quantity of acid is too small, moreover, to affect the health of the cattle. It is clear that either iron enamelled cauldrons, or those made of copper, can only be used with open fire; where steam is at hand, well made wooden tanks may serve.

**A New Manure.**—M. Auvillain.—The author treats residues and offal of fish, first boiling the same, with addition of 1-10th of the weight of the mass of any cheap oil, heating up to from  $120^\circ$  to  $140^\circ$ . By this means, all the water is expelled from the offal, which is next treated with sulphide of carbon, whereby the oil naturally contained in the fish, as well as that which was added, is extracted, leaving a mass quite dry, and containing from 5 to 6 per cent of nitrogen and from 12 to 15 per cent of phosphate of lime.

**Production of Petroleum (Paraffin Oils) in the United States.**—L. Péaud.—It appears that the quantity produced of the substance alluded to is largely on the increase, since the average daily production amounted, in 1868, to 10,863 barrels, and in 1869 to 13,197 barrels. The stock on the first day of this year was, in the States and Canada jointly, 1,238,000 barrels.



*Berichte der Deutschen Chemischen Gesellschaft zu Berlin*, No. 3, 1870.

This number contains the following original papers:—

**Preparation of Ethylamines on the Large Scale.**—Dr. A. W. Hofmann.—This lengthy paper treats on the preparation of ethylamines, by applying thereto the by-products obtained during the manufacture of hydrate of chloral. This material is treated in closed vessels, at 100°, with a concentrated alcoholic solution of ammonia.

**Synthesis of Aromatic Acids.**—V. Meyer.—This paper is subdivided into the following groups:—Synthesis of benzoic acid; synthesis of isophthalic acid; constitution of substituted benzoic acids.

**Contribution to our Knowledge of the Constitution of Camphor.**—V. Meyer.—This very lengthy paper, full of complicated formulæ, is not well suited for abstraction. In a foot-note, the author observes that most of the recently published works on organic chemistry quote the melting-point of camphoric acid at 62.5, whereas some six years ago, the researches of MM. Tollens and Fittig proved the melting-point of that acid to be at about 176°; and the author's researches have confirmed this particular.

**Crystallised Hydrate of Soda.**—O. Hermes.—The author states that, during the cold weather which prevailed at Berlin some two months ago, he had the opportunity of obtaining, from an aqueous solution of caustic soda (sp. gr., 1.365), beautiful crystals of rhomboprismatic shape, perfectly transparent, fusing at 6°, and containing 30.09 NaO. The formula of this compound is, therefore,  $\text{NaO} + 8\text{HO}$ ; or, according to more recent views,  $2\text{NaOH} + 7\text{H}_2\text{O}$ .

**Contribution to our Knowledge of the Iodides.**—E. Meusel.—The author describes iodide of copper, which he obtained by the slow action of metallic copper upon hydriodic acid, in the shape of faintly greenish yellow-coloured tetrahedral crystals, which become dark coloured by exposure to light. The author next describes some experiments relating to the action of light on the chlorides, fluorides, iodides, and bromides; and, lastly, gives a review of the various analytical methods in use for the quantitative analysis of insoluble iodides. The author's method is based upon the solubility of the iodides of mercury, lead, silver, and copper in hyposulphite of soda; the metals are precipitated from that solution by hydrosulphuret of ammonium, and all the iodine remains in solution. After removal of the sulphurets of the metals, ammonia is added to the filtrate, and the liquid evaporated, so as to expel the bulk of the sulphur in the shape of sulphide of ammonium. Solution of caustic soda is next added; and, after evaporation to dryness, the saline mass is ignited, next dissolved in a small quantity of water, solution of chloride of iron is added in excess, and the iodine, after having been taken up by iodide of potassium, is estimated by titration.

**On those Haloid Compounds which Correspond to Picric Acid and Dinitro-Phenol, and on some Derivatives thereof.**—C. Clemm.—Under the above title, this very lengthy paper treats on chloro-nitro-benzol, chloro-dinitro-benzol, bromo-dinitro-benzol, and on nitro-derivatives of the haloid compounds here named.

**On so-called Chloraceten.**—A. Kekulé and Th. Zincke.—After referring, at some length, to the researches of various scientific chemists who have been occupied with this subject, the authors, in their lengthy monograph, give a series of experiments, and come to the conclusion that chloraceten is simply a mixture of aldehyde and paraldehyde, containing hydrochloric acid or chlorocarbonic gas.

**Condensation of Aldehydes.**—A. Kekulé.—Not suited for any useful abstraction.

**Products of the Oxidation of Paraffin.**—E. Willigk.—This paper, a preliminary notice, contains the description of a series of experiments, whereby pure paraffin, treated at a high temperature with a mixture of nitric and sulphuric acids, is made to yield materials which belong to the series of fatty acids. The author's researches on this subject are not, however, quite complete.

#### No. 4.

Contains—

**Products of Distillation of Coal-Tar which Boil at a High Temperature.**—C. Graebe and C. Liebermann.—The authors state that they obtained, from a tar distillery at which the distillation is pushed till a coke only remains, a solid, lemon-yellow coloured, fatty-looking material, fusing at 150°, while its boiling-point is higher than that of mercury. This material was soon recognised by the authors to be a mixture of various substances, but chiefly made up of chrysen, which, after having been purified, was found to fuse at from 245°–248°, and difficultly soluble in alcohol, ether, and sulphide of carbon, a little more readily soluble in boiling anhydrous acetic acid and in benzol. The authors have studied, also, some of the products of oxidation of chrysen, and among these a body called chrysochinon,  $\text{C}_{18}\text{H}_{10}\text{O}_2$ . The formula of chrysen is  $\text{C}_{18}\text{H}_{12}$ .

**Betaine and its Constitution.**—C. Schiebler.—This lengthy paper is illustrated by diagrams, and, therefore, like the following—

**Identity of Oxyneurine and Betaine.**—Dr. O. Liebreich.—Not suited for abstraction.

**Chlorophosphide of Nitrogen.**—H. Wichelhaus.—This paper contains a review of the labours of various authors on this subject.

**Description of an Improved Shape and Arrangement of Hofmann's Apparatus for the Determination of Vapour Densities.**—H. Wichelhaus.—This paper is illustrated by a woodcut, essentially required to the proper understanding of the contents.

**Our Present Knowledge of the Mineralogico-Chemical Properties of Meteorites.**—C. Rammelsberg.—A lengthy essay, chiefly of mineralogical interest.

**Contribution to the History of the Platinum Bases.**—Charles Gordon.—A review of the labours of Reiset, Magnus, Raewsky, and others on this subject.

**On Paytine.**—O. Hesse.—Under this name, derived from the seaport of Payta (Peru), the author describes a new alkaloid, found by him in the cinchona bark shipped from the place alluded to. Paytine,  $\text{C}_{21}\text{H}_{24}\text{N}_2\text{O} + \text{H}_2\text{O}$ , is readily soluble in ether, benzol, chloroform, and alcohol, but very difficultly soluble in water; fuses at 156°; exhibits an alkaline reaction to test-paper, but does not very readily form salts, nor is it quite neutralised with acids. On being heated with soda-lime, paytine yields a substance, paiton, free from nitrogen.

**New Organic Phosphorus Compound.**—L. Darmstädter and A. Henniger.—The author describes a material accidentally discovered by him, and found to be cyan-ethyl-phosphide,  $\text{C}_3\text{H}_6\text{NP}$ . In 100 parts—C, 41.37; H, 6.90; N, 16.09. Since the quantity obtained was very small, no other experiments could be made with this substance.

**Solid Crotonic Acid.**—A. Claus.

**Thebalaetic Acid.**—After referring to Dr. Stenhouse's labours on this subject, the author states that, having obtained from Messrs. Smith, morphine manufacturers, a quantity of the thebalaetic acid of lime, he instituted therewith a series of experiments, described at length, with the view of ascertaining the truth of the statement that thebalaetic acid is identical with lactic acid; and, as far as the author's researches, not yet quite finished, go, this view is confirmed.

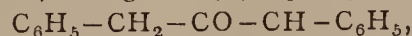
**Chemical Constitution of Uric Acid and its Derivatives.**—Dr. H. Kolbe.—A lengthy monograph, filled with a very large number of formulæ.

**Thermo-Chemical Researches on the Phenomena of Neutralisation and Basicity (Basicität) of Acids.**—J. Thomsen.—A lengthy paper, containing a series of tabulated forms.

**Basicity and Rational Formulæ of Hydrosulphuric Acid.**—J. Thomsen.

**Preparation of Acetones from Mercuro-Diphenyl.**—R. Otto.—Only a series of lengthy formulæ.

**Contribution to the History of Phenyl-Acetic Acid.**—Br. Radziszewsky.—Nitrile of phenyl-acetic acid is a limpid, colourless liquid, boiling at 229°; sp. gr. at 8°, 1.0155. When this fluid is heated with hydrochloric acid it is converted into chloride of ammonium and phenyl-acetic acid. The nitrile alluded to yields, with nitric acid of 1.5 sp. gr.—A mono-nitrited derivative,  $\text{C}_6\text{H}_4(\text{NO}_2)\text{CH}_2\text{CN}$ , a solid crystalline compound, fusing at 114°; diphenyl-aceton—



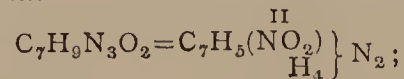
obtained by the dry distillation of phenyl-acetic acetate of baryta, is, after being purified, a crystalline substance, soluble in alcohol, fusing at 30° and boiling at 320°; phenyl-aceton,  $\text{C}_6\text{H}_5 - \text{CH}_2 - \text{CO} - \text{CH}_3$ , is, when pure, a pleasant smelling fluid, boiling at 215°, and having, at 3°, a sp. gr. of 1.010. This fluid yields, on being first treated with chloride of phosphorus, and next with an alcoholic solution of potassa, in sealed tubes, a substance which, the author says, appears to be a hydrocarbon.

#### No. 5.

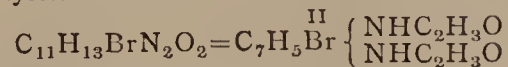
This number contains the following original papers and memoirs:—

**Modifications of Sulphuric Anhydride.**—Schultz-Sellack.—There exist two modifications of the anhydride of sulphuric acid, viz.— $\alpha$  anhydride, solidifying at +16°, forming lengthy colourless prisms, which fuse at the same temperature, and boil at 46°.  $\beta$  sulphuric anhydride, formed from the former at temperatures below 25°; its crystals are needle-shaped; it fuses above 50°, and is then re-converted into the  $\alpha$  variety.

**Derivatives of Trinitro-Toluol and Toluylen-Diamine.**—F. Tiemann.—This lengthy paper contains the following sections:—Nitro-toluylen-diamine—



brom-diacettoluylen-diamine—



monacettoluylen-diamine; dibrommonacettoluylen-diamine; toluylen-oxametane.

**Di- and Tri-Nitrited Benzoic Acids.**—F. Tiemann and W. E. Judson.

**Contribution to our Knowledge of the Derivatives of Xylidine.**—B. Genz.—Sub-divided into sections on—Monobrom-xylidine; aceto-bibrom-xylidide; bibrom-xylidine; xylil-carbamide; dixylil-carbamide; dixylil-oxamide; dixylil-guanidine.

**Products of the Decomposition of Hæmoglobine.**—F. Hoppe-Seyler.

**Contribution to our Knowledge of Azo Compounds (Azoverbindungen).**—A. Kekulé and C. Hidegh.

**Quantivalence of Sodium.**—O. P. Köhler.—This paper is written as a reply to Professor Wanklyn's papers on this subject published in the CHEMICAL NEWS.

**Some of the Constituents met with in the Fruits of the Cerasus Acida, Borckh.**—F. Rochleder.

The Society for the Promotion of Industry in Prussia has published in this number that portion of its programme for competitive essays which relates to chemistry. The silver medal of the Society (or its value in money) and a sum of £120 will be given to him who hands in to the Society the description of an improved (and, by practica



experience, found to answer) coke oven-construction, whereby coke of first-rate quality is produced and the products of the volatilisation economically condensed. The Society's silver medal (or its value), and, moreover, a premium of £75, for the best method of quantitative estimation of phosphorus in iron ores, pig-iron, steel, and wrought-iron. The following conditions must be complied with:—The result must be obtained in half an hour—that is to say, this time to be reckoned, if the assay is by the wet way, from the moment the substance is dissolved; if by the dry way, from the moment after the weighing off of the previously-pulverised material. The results must be correct—within 0·01 per cent of phosphorus, when the substance under investigation contains 90 per cent of iron and upwards; within 0·02 per cent for from 75 to 90 per cent of iron; within 0·05 per cent for from 50 to 75 per cent of iron; within 0·1 per cent for from 20 to 50 per cent of iron. The method need not apply to substances containing less than 20 per cent of iron.

## NOTES AND QUERIES.

**Detection of Strychnine.**—(Reply to "Alpha.")—Stas's method will be found in Fresenius's "Qualitative Analysis," p. 243.—A. V.

**Drop Black.**—I would like to know the method of preparing the substance sold under the names of drop black and imperial drop black. I cannot find any information in books regarding it.—P. H.

**Ozone.**—Upon examining the contents of some bottles in which N had been prepared by the slow oxidation of iron filings, I found abundant evidence of ozone, both by smell and by the ordinary starch test.—T. B.

**Latent and Sensible Heat.**—(Reply to "Compound.")—It would be very difficult, if not altogether impossible, to estimate the amount of heat you allude to; but the cause of it is that a chemical combination takes place, attended by the phenomena you allude to; and that this explanation holds good has been proved by Dr. J. H. Croockewit, who, some twenty years ago, made a series of experiments, on a sufficiently large scale, on the metallic alloys. His researches have been published as a separate Dutch work; but, as far as our recollection goes, the author was not able to estimate the amount of heat set free during the sudden combination of the metals you allude to. The cause of this failure is the obvious fact of the want of proper means of estimating high temperatures with sufficient accuracy.

**Pyro-Electric Gilding.**—In your issue of the 14th inst., I see a quotation from the *Bulletin de la Société d'Encouragement pour l'Industrie Nationale* (No. 206, February, 1870), to this effect:—"Pyro-Electric Gilding Invented by M. Masselotte, to whom a Prize of £20 has been given.—M. Barral.—From the author's report, it appears that this invention is very valuable, since it possesses all the advantages of the best method of mercurial gilding, without being at all detrimental to the workmen." I have been practising this system of gilding and silvering now for over five years under this very title, and was the first to invent the process and used the title. In 1865, I patented this method in France; and in 1868 I patented an improvement on this method in France. M. Masselotte may not have seen my specification, but using the exact title looks suspicious.—J. BAYNES THOMPSON, Electro-Metallurgist, Pyro-Plater, &c.

[By referring to the original report, of which we gave an abstract, Mr. Thompson could at once see if the two processes are similar.—ED. C. N.]

**Sulphur in Coal-Gas.**—The following note of the formation and condensation of sulphuric acid by the combustion of sulphur compounds in coal-gas in a common fish-tail burner shaded by an ordinary ground-glass globe may, perhaps, interest some of your readers:—Having occasion to take down a gas globe, I noticed a number of brown drops of liquid scattered over its internal surface; on collecting and testing them, they were found to consist of pretty concentrated sulphuric acid, the comparatively high degree of concentration being due to the great temperature acquired by the globe, the heat being far greater than the hand could bear. The brown colour was, doubtless, produced by the carbonisation of organic dust. Also two or three strips of copper, placed over the mouth of the globe to support a shade, were found to be coated with anhydrous cupric sulphate. From the short time which had been taken in the production of the acid (a fortnight, the gas burning for about three hours of an evening, at the rate of 5 ft. an hour), I should think the gas was rather too rich in sulphur to be an unmitigated good to the consumer.—ARCHD. LIVERSIDGE.

## MEETINGS FOR THE WEEK.

MONDAY, May 2nd.—Medical, 8.

— London Institution, 4.

— Royal Institution, 2. Annual Meeting.

TUESDAY, 3rd.—Institution of Civil Engineers, 8.

— Royal Institution, 3. Prof. Blackie, "Principles of Moral Philosophy."

WEDNESDAY, 4th.—Society of Arts, 8.

THURSDAY, 5th.—London Institution, 7.30.

— Chemical, 8.

— Royal, 8.30.

— Royal Society Club, 6.

— Royal Institution, 3. Prof. Tyndall, "On Electricity."

FRIDAY, 6th.—Geologists' Association, 8.

— Royal Institution, 8. Mr. Proctor, "Star Grouping, &c."

SATURDAY, 7th.—Royal Institution, 3. Prof. Grant, "Astronomy of Comets."

## MANUAL OF CHEMISTRY FOR THE SUMMER SESSION OF THE MEDICAL SCHOOLS:

Including Analysis, Chemical Toxicology, Directions for Examining Morbid Urine, Urinary Sediments and Calculi, and the Chemistry of the British Pharmacopœia.

## CHEMISTRY: GENERAL, MEDICAL, AND PHARMACEUTICAL.

By JOHN ATTFIELD, PH.D., F.C.S.,

Professor of Practical Chemistry to the Pharmaceutical Society of Great Britain; many years Demonstrator of Chemistry at St. Bartholomew's Hospital.

**The Lancet.**—"It contains a most admirable digest of what is specially needed by the medical student in all that relates to practical chemistry, and constitutes for him a sound and useful text-book on the subject. . . . We commend it to the notice of every medical, as well as pharmaceutical, student. We only regret that we had not the book to depend upon in working up the subject of practical and pharmaceutical chemistry for the University of London, for which it seems to us that it is exactly adapted. This is paying the book a high compliment."

**The Chemical News.**—"Dr. Attfield's book is written in a clear and able manner; it is a work *sui generis* and without a rival; it will be welcomed, we think, by every reader of the 'Pharmacopœia,' and is quite as well suited for the medical student as for the pharmacist."

**The Pharmaceutical Journal.**—"It is almost the only book from which the medical student can work up the pharmacopœial chemistry required at his examinations."

**Medical Times and Gazette.**—"A valuable guide to practical medical chemistry, and an admirable companion to the 'British Pharmacopœia.' It is rare to find so many qualities combined, and quite curious to note how much valuable information finds a mutual interdependence."

**The British Medical Journal.**—"At page 350 of the current volume of this journal, we remarked that 'there is a sad dearth of (medical) students' text-books in chemistry.' Dr. Attfield's volume, just published, is rather a new book than a second edition of his previous work, and more nearly realises our ideal than any book we have before seen on the subject."

**The Chemist and Druggist.**—"The introduction of new matter has not destroyed the original character of the work, as a treatise on pharmaceutical and medical chemistry, but has simply extended the foundations of these special departments of the science."

**The Medical Press and Circular.**—"We believe that this Manual has been already adopted as the class-book by many of the professors in the public schools throughout the United Kingdom. . . . In pharmaceutical chemistry applied to the pharmacopœia, we know of no rival. It is, therefore, particularly suited to the medical student."

**Dublin Quarterly Journal of Medical Science.**—"Dr. Attfield's book contains more information of a practical character than is to be found in most works of its class. It is just the kind of chemical manual which is most suited to the wants of the student of medicine. . . . We cordially recommend it."

**Nature.**—"We have derived much satisfaction from the perusal of Dr. Attfield's work; it is eminently practical in its character, and is written with a just appreciation of the small amount of time for the study of chemistry at the disposal of the student in medicine and pharmacy."

**The American Journal of Pharmacy.**—"On the whole, it may be truthfully said of this edition that Dr. Attfield has increased its scientific accuracy, extended its scope, and improved its adaptation as a manual of practical chemistry for pharmaceutical and medical laboratory students."

**The Chicago Pharmacist and Chemical Record.**—"We can heartily commend the work of Professor Attfield as the *best* for the use of students of medicine and pharmacy that has yet come under our notice; and we hope it may be re-published in this country."

**Moniteur Scientifique.**—"Dans un in-12 de plus de 600 pages l'auteur a magnifiquement développé une chimie minérale et organique en l'appliquant à deux sciences qui lui sont solidaires, la médecine et la pharmacie. . . . Nous pouvons dire qu'il est indispensable aux chimistes par la variété des matières qu'il renferme et par le choix judicieux que l'auteur a apporté de tout ce qui se rattache à la chimie. . . . Nous espérons qu'une traduction Française viendra augmenter le nombre des lecteurs de son ouvrage."

**Journal de Pharmacie et de Chimie.**—"Le plan adopté par le savant professeur a un caractère original, qui lui assure une place distinguée parmi les ouvrages destinés à répandre la connaissance de la chimie. . . . Nous avons en France nombre de bon ouvrages destinés à faire connaître la chimie, mais nous sommes persuadés que, traduit en notre langue, le livre de M. Attfield pourrait rivaliser avec eux et ne compterait pas moins de lecteurs."

JOHN VAN VOORST, 1, PATERNOSTER ROW.



# THE CHEMICAL NEWS.

VOL. XXI. No. 545.

## ON THE ESTIMATION OF PHOSPHORIC ACID AS AMMONIO-PHOSPHATE OF MAGNESIA.

By THOMAS R. OGILVIE.

THE estimation of phosphoric acid in minerals containing fluorine, oxide of iron, and alumina, is a matter of considerable difficulty.

In the method recommended by Church, in his "Laboratory Guide" (p. 50), the first step is to dissolve the mineral in acid and evaporate the solution to dryness. Other authorities also state that the acid solution should be brought to dryness before proceeding to separate the lime.

Some analysts, however, neglect this part of the process, from the impression that it has no influence on the estimation of the phosphoric acid, and that it is only necessary when the siliceous matter is required for a full analysis. I am not aware that any experiments have been published to show that this impression is an erroneous one; the following, perhaps, will be sufficient:—

(1.) A gramme of Cambridge coprolites was dissolved in moderately-strong hydrochloric acid, evaporated to dryness, the residue again dissolved in acid, the lime separated with oxalate of ammonia, citric acid added to hold up oxide of iron and alumina, the solution made alkaline with ammonia, and the phosphoric acid precipitated with "magnesia-mixture." A perfectly granular precipitate was obtained, which, after standing for twelve hours, was washed, dried, ignited, and weighed, and found to be equivalent to 47.44 per cent tribasic phosphate of lime.

(2.) Another gramme of the same coprolites was treated in exactly the same way, with the exception that the acid solution was *not* brought to dryness. The ammonio-phosphate of magnesia, as it gradually formed, presented the usual appearance; but, when stirred up after a few minutes, a white flocculent body was also observed. After standing for the usual time, the whole precipitate was collected, washed, dried, ignited, and weighed, and gave 53.04 per cent phosphate of lime.

(3.) A third gramme was treated as in (2), with the difference that, after the addition of citric acid, the solution was made alkaline with ammonia, and allowed to stand. In a short time, a white flocculent precipitate formed, which was filtered, washed, dried, ignited, and weighed.

To the clear ammoniacal filtrate, "magnesia-mixture" was added; and a granular precipitate, free from any flocculent matter, was obtained, equivalent to 47.20 per cent phosphate of lime. This closely corresponds with the result (viz., 47.44 per cent) got in (1) by evaporating to dryness.

The flocculent precipitate got by ammonia weighed 4.05 per cent. Had it not been removed, it would have been taken as ammonio-phosphate of magnesia, and, as such, been equivalent to 5.66 per cent phosphate of lime; this, added to 47.20 per cent, gives 52.86 per cent, against 53.04 per cent found in (2) by weighing the flocculent precipitate along with the ammonio-phosphate of magnesia.

These experiments were repeated with another sample of Cambridge coprolites, and with similar results.

(4.) A gramme was dissolved in acid, and brought to

dryness, and the phosphoric acid estimated as ammonio-phosphate of magnesia. A result equal to 52.36 per cent phosphate of lime was found.

(5.) Another gramme was treated in the same way, but not brought to dryness. A mixed granular and flocculent precipitate was got, which, on being weighed and calculated as pure pyro-phosphate of magnesia, gave 57.65 per cent phosphate of lime.

(6.) A third gramme was proceeded with as in (3). The solution, after the addition of citric acid, was made alkaline with ammonia, and the flocculent precipitate which formed was separated and weighed. "Magnesia-mixture" was then added to the filtrate; and a granular precipitate was obtained equal to 52.78 per cent phosphate of lime, corresponding to 52.36 per cent found in (4) by bringing to dryness. The separated flocculent precipitate, weighed as pyrophosphate of magnesia, gave 4.47 per cent phosphate of lime; and this, added to 52.78 per cent, got after separating the flocculent matter, gives 57.25 per cent, which agrees with the result (viz., 57.68 per cent) got in (5) by weighing the granular and flocculent precipitates together.

In these experiments, care was taken that the lime was perfectly separated, and that sufficient citric acid was present to hold up oxide of iron and alumina.

The precipitate which forms on the addition of ammonia to the citric acid solution when the mineral has not, at the outset of the process, been brought to dryness, consists of silica, alumina, and sesquioxide of iron, as silicate, and, when carefully washed, is free from phosphoric acid. In the case of sombreroite, some ammonio-phosphate of magnesia would also come down, owing to the presence of a considerable quantity of magnesia in that mineral. But, with coprolites and other phosphatic minerals, which contain only minute quantities of magnesia, neither phosphoric acid nor magnesia is found, unless the flocculent precipitate is not filtered from the solution for a few hours.

All phosphatic minerals which contain fluorine, oxide of iron, and alumina, give this precipitate. Thus, a sample of—

	Gave a flocculent precipitate weighing	Calculated as 3CaOPO <sub>5</sub> .
	Per cent.	
Charleston phosphate .. ..	2.40 .. ..	3.35
Osteolite .. ..	2.45 .. ..	3.45
Rhenish phosphate.. ..	3.25 .. ..	4.54
Bedford coprolites .. ..	3.80 .. ..	5.31
Suffolk coprolites .. ..	4.50 .. ..	6.28

These results, of course, vary in different samples.

Those minerals containing fluorine, and only a trace of oxide of iron and alumina, such as Canadian apatite and Spanish phosphorite, give no appreciable flocculent precipitate. A sample of sombreroite was also examined, but, as it was exceptionally free from oxide of iron and alumina, it gave no flocculent precipitate.

It may be mentioned that, when coprolites, or other ferruginous phosphatic mineral, is moistened with sulphuric acid, gently heated, and the fluo-silicic acid which forms driven off, then dissolved in hydrochloric acid, and the lime removed without the solution being brought to dryness, no flocculent precipitate is got. And neither do "superphosphates" which have been prepared from these minerals give a precipitate.

It would thus seem that, in the analysis of the majority of the phosphatic minerals at present in use by manure manufacturers, special care must be taken to obtain a pure and perfectly granular precipitate of ammonio-phosphate of magnesia, either by evaporating the acid solution to dryness, or by separating the precipitate which forms on the addition of ammonia to the solution containing citric acid; otherwise an erroneously high result is got.

Shaw's Water Chemical Works, Greenock,  
April 27th, 1870.



ON A

## CAUSE OF ERROR IN ELECTROSCOPIC EXPERIMENTS.\*

By Sir CHARLES WHEATSTONE, F.R.S.

To arrive at accurate conclusions from the indications of an electroscope or electrometer, it is necessary to be aware of all the sources of error which may occasion these indications to be misinterpreted.

In the course of some experiments on electrical conduction and induction which I have recently resumed, I was frequently delayed by what at first appeared to be very puzzling results. Occasionally I found that I could not discharge the electrometer with my finger (or only to a certain degree), and that it was necessary, before commencing another experiment, to place myself in communication with a gas-pipe which entered the room. How I became charged I could not at that time explain; the following chain of observations and experiments, however, soon led me to the true solution.

I was sitting at a table not far from the fire-place, with the electrometer (one of Peltier's construction) before me, and was engaged in experimenting with discs of various substances. To ensure that the one I had in hand (which was of tortoiseshell) should be perfectly dry, I rose, and held it for a minute before the fire. Returning, and placing it on the plate of the electrometer, I was surprised to find that it had apparently acquired a strong charge, deflecting the index of the electrometer beyond  $90^\circ$ . I found that the same thing took place with every disc I thus presented to the fire, whether of metal or any other substance. My first impression was that the disc had been rendered electrical by heat, though it would have been extraordinary that, if so, such a result had not been observed before; but, on placing it in contact with a vessel of boiling water, or heating it by a gas-lamp, no such effect was produced. I next conjectured that the phenomenon might arise from a difference in the electrical state of the air in the room and that at the top of the chimney; and, to put this to the proof, I adjourned to the adjacent room, where there was no fire, and, bringing my disc to the fire-place, I obtained precisely the same results. That this conjecture, however, was not tenable was soon evident, because I was able to produce the same deviation of the needle of the electrometer by bringing my disc near any part of the wall of the room. This seemed to indicate that different parts of the room were in different electrical states; but this, again, was disproved by finding that, when the positions of the electrometer and the place where the disc was supposed to be charged were interchanged, the charge of the electrometer was still always negative. The last resource was to assume that my body had become charged by walking across the carpeted room, though the effect was produced even by the most careful treading. This ultimately proved to be the case; for, resuming my seat at the table, and scraping my foot on the rug, I was able, at will, to move the index to its greatest extent.

Before I proceed further, I may state that a gold-leaf electrometer shows the phenomena as readily.

When I first observed these effects, the weather was frosty; but they present themselves, as I have subsequently found, almost equally well in all states of the weather, provided the room be perfectly dry.

I will now proceed to state the conditions which are necessary for the complete success of the experiments, and the absence of which has prevented them from being hitherto observed in the striking manner in which they have appeared to me.

The most essential condition appears to be that the boot or shoe of the experimenter must have a thin sole, and be perfectly dry; a surface polished by wear seems to augment the effect. By rubbing the sole of the boot

against the carpet or rug, the electricities are separated; the carpet assumes the positive state, and the sole the negative state. The former, being a tolerable insulator, prevents the positive electricity from running away to the earth; while the sole of the foot, being a much better conductor, readily allows the charge of negative electricity to pass into the body.

So effective is the excitation that, if three persons hold each other by the hands, and the first rubs the carpet with his foot while the third touches the plate of the electrometer with his finger, a strong charge is communicated to the instrument.

Even approaching the electrometer by the hand or body, it becomes charged by induction at some distance.

A stronger effect is produced on the index of the instrument if, after rubbing the foot against the carpet, it be immediately raised from it. When the two are in contact, the electricities are in some degree coerced or dissimulated; but, when they are separated, the whole of the negative electricity becomes free, and expands itself in the body. A single stamp on the carpet, followed by an immediate removal of the foot, causes the index of the electrometer to advance several degrees; and, by a reiteration of such stamps, the index advances  $30^\circ$  or  $40^\circ$ .

The opposite electrical states of the carpet and the sole of the boot were thus shown:—After rubbing, I removed the boot from the carpet, and placed on the latter a proof-plate (*i.e.*, a small disc of metal with an insulating handle), and then transferred it to the plate of the electrometer: strong positive-electricity was manifested. Performing the same operation with the sole of the boot, a very small charge was carried, by reason of its ready escape into the body.

The negative charge assumed by sole-leather, when rubbed with animal-hair, was thus rendered evident:—I placed on the plate of the electrometer a disc of sole-leather, and brushed it lightly with a thick camels'-hair pencil. A negative charge was communicated to the electrometer, which charge was principally one of conduction, on account of the very imperfect insulating power of the leather.

Various materials, as india-rubber, gutta-percha, &c., were substituted for the sole of the boot; metal plates were also tried. All communicated negative electricity to the body. Woollen stockings are a great impediment to the transmission of electricity from the boot; when these experiments were made, I wore cotton ones.

When I substituted for the electrometer a long wire galvanometer, such as is usually employed in physiological experiments, the needle was made to advance several degrees.

At the meeting of the British Association, at Dublin, in 1857, Professor Loomis, of New York, attracted great attention by his account of some remarkable electrical phenomena observed in certain houses in that city. It appears that, in unusually cold and dry winters, in rooms provided with thick carpets, and heated by stoves or hot-air apparatus to  $70^\circ$  F., electrical phenomena of great intensity are sometimes produced. A lady, walking along a carpeted floor, drew a spark  $\frac{1}{4}$  inch in length, between two metal balls, one attached to a gas-pipe, the other touched by her hand; she also fired ether, ignited a gas-light, charged a Leyden jar, and repelled and attracted pith balls similarly or dissimilarly electrified. Some of these statements were received with great incredulity at the time both here and abroad; but they have since been abundantly confirmed by the Professor himself and by others (see Silliman's *American Journal of Science*, July, 1858).

My experiments show that these phenomena are exceptional only in degree. The striking effects observed by Professor Loomis were feeble, unless the thermometer was below the freezing-point, and most energetic when near zero, the thermometer in the room standing at  $70^\circ$  F. Those observed by myself succeed in almost any weather, when all the necessary conditions are fulfilled. Some of

\* Read before the Royal Society, April 28th, 1870.



these conditions must frequently be present, and experimentalists cannot be too much on their guard against the occurrence of these abnormal effects: I think I have done a service to them, especially to those engaged in the delicate investigations of animal-electricity, by drawing their attention to the subject.

## PLATINISED LOOKING-GLASSES.

By C. WIDEMANN.

THE glass, being prepared by the usual method, is soaped, polished, and cleansed. The Platinised-Glass Works at Wailly-sur-Aisne, France, where this new industry is carried on, possesses highly-improved polishing-tables, so much so that the polishing operation occupies only three hours. At the St. Gobain Works, this operation requires a manipulation of forty-eight hours.

After the cleaning operation, the glass is carried into the platinising-shop, and the composition giving the metallisation is applied to the glass by means of a brush. The plate is placed vertically, and receives the platinising liquid to a convenient thickness: it is first applied from top to bottom, then from left to right, and at last from right to left; by these means the oily coating is equalised. This composition, containing a large quantity of essence of lavender, spreads itself instantly over the surface, drying slowly and without any running. Great care must be taken to avoid all dampness and dust; dampness would crisp and wrinkle the surface, and the dust would destroy the regularity of the work, as every grain of dust absorbs liquids concentrically, and thus deprives the surrounding parts.

The platinising composition needs nothing else, to be perfect, than great cleanliness on the part of the operator.

In making the platinising liquid, the following materials are used:—100 grms. carefully-laminated platina, in very thin sheets, are taken; it is soaped, in order to remove all the grease that might have accumulated during the laminating operation; it is then dissolved in an aqua regia, composed of 400 grms. nitric acid for 1000 grms. pure hydrochloric acid; it is heated, by means of a sand-bath, to dryness, care being taken not to decompose the chloride by excessive heat; it is then crushed in a porcelain or glass mortar, and laid on a grinding glass-plate, where it is mixed with small quantities at a time of essence of lavender (rectified), care being taken not to work at too high temperature, or the reaction would take place on this glass plate. Having added about 1400 grms. of essence of lavender, the mixture is collected in a porcelain dish, and left to itself for eight days without the least disturbance. The liquid is next decanted, filtered, and left again, for six days; and this filtered liquid must then be about 5° Baumé at the acid test. For the above quantity, 25 grms. litharge and 25 grms. borate of lead are taken, and ground to an impalpable powder, with 8 to 10 grms. essence of lavender. This last mixture is then added and stirred with the platinising liquid. It is then applied as above described, care being always taken to avoid dampness and dust.

As soon as the glass plate to be platinised has received the metallic coat, and is sufficiently dry, it is placed in muffles, formed of a frame of cast-iron, tongued and grooved, and the parts of which slide in each other.

The fire-place is placed at the back of the oven, which arrangement gives free access to the door through which the glass is placed in the oven. Movable frames are placed in the cast-iron frame, and receive the glasses to be heated, maintaining them in a parallel and vertical position. Hooks, properly constructed, support a large number of these frames. Also, movable sheets allow glasses of different sizes to be placed in these frames.

The vertical and longitudinal section of the oven is a long parallelogram, and its cross section is a square.

The cooking is regular, and the accidents of fire are regulated by registers or iron grates in the posterior and anterior part of the oven. A series of muffles are placed under the dome.

The platinised mirror thus obtained is of great solidity, and no metal is more resistant to the influence of atmospheric agents. Even when a mirror is thrown into a great fire, at the temperature at which the glass melts, it will have retained its metallic surface. The mirrors do not give false tints to coloured objects, as the common mercury-alloy does.

The reflection being obtained by the anterior surface, there exists no double reflection; but what is still more remarkable is that the substitution of platina for tin and mercury is that it allows any kind of glass to be transformed into a mirror. The vitreous matter is polished on one face only, and, having been submitted to the platinising process, reflects images without distortion from the surface of the metal itself.

Let us now come to the actual process in use. The following conditions had to be fulfilled:—

After having suppressed the use of mercury, the glass was to be perfectly colourless, and deprived of every defect. The cost had to be reduced, or the old routine would not give place to progress. Not only has Dodé suppressed the use of mercury, but he has, by his improvement, been able to make better mirrors; for he hides, by his process, the faults in the glass plates, and obviates half the work of planing and polishing. In order to obtain this result, it was necessary to apply the reflecting surface on the front of the glass plate, and not at the posterior surface.—*Scientific American*.

## ON THE ABSORPTIVE POWER OF SOIL.\*

By ROBERT WARINGTON, F.C.S.

THE chemistry of soil is a branch of science at present but imperfectly investigated, and confessedly full of difficulties. In its full meaning, it implies an acquaintance with all the various forms of matter contained in soil, and also a perfect knowledge of their behaviour under the various conditions to which soil is liable. The chemist has comparatively little difficulty in analysing a soil. He can pull it to pieces, and determine with considerable accuracy the proportion of the various elements which together compose it; but the results thus obtained are only a very partial help in the study of the chemical properties of soil. The analysis fails to tell him in what relation the various elements stood to each other in the original soil, in what forms of combination they actually occurred. The chemist is thus, at starting, only imperfectly acquainted with the compounds present in any particular soil, the chemical properties of which he is about to study. But this is not the only difficulty under which he labours,—he is ignorant to a very considerable extent of the properties and behaviour of those substances which he believes to be present. The constituents which make up the bulk of his soil may be classed under certain heads,—as water, quartz, silicates, hydrated oxides, carbonates, and humus; but how little is known respecting the behaviour of most of these substances under the conditions met with in soil! What is their action towards the various salts, which form so important a part of plant-food? What is their action towards the various gases of the atmosphere? What is their behaviour in the presence of decaying vegetable or animal matter? What, again, is their influence on each other when present in different proportions? The subject has been too little studied to allow of any but imperfect answers being given to these questions. It naturally follows, from this immature condition of the science, that, while several of the properties of

\* *Practice with Science*, vol. ii.



soil have been very ably investigated, the origin and cause of these properties have been but indistinctly traced: one investigator ascribes a phenomenon to the action of one of the ingredients of soil, while another sees, in the same phenomenon, the sole action of a different soil-ingredient.

In the present paper, we propose to confine our attention to one of the best known properties of soils—their remarkable faculty of withdrawing certain substances from their solution in water.\* The subject has received attention only in the last twenty years. It has, perhaps, been more fully investigated than any other part of the chemistry of soil, and richly deserves further study. Did we thoroughly understand it, the whole subject of the condition of plant-food within the soil would be at our command; we might then hope to be able to discriminate between available and non-available plant-food, and agriculture would gain largely by the increase to our knowledge.

Many an observant farmer must have noticed, long before agricultural chemistry had its birth, that soil has the property of removing very quickly the odour and colour of liquid manure; but the observation, however intelligent, resulted in no permanent addition to our stock of knowledge. Near to our own day, two thoughtful men noticed this fact, and fortunately each of these observers was acquainted with a chemist. Mr. H. S. Thompson, in 1845, made a few careful experiments on the subject, with the assistance of Mr. Spence, a chemist at York, but did not publish his results till five years later. Mr. Huxtable, a short time after, drew the attention of Professor Way to the same subject; the result was the publication, in 1850, of Way's now classical paper "On the Power of Soils to Absorb Manure,"† followed by two other papers, in 1852 and 1855. Numerous chemists have since made researches on the subject, especially in Germany, and the subject is still being vigorously prosecuted. We propose to give some account of the results arrived at, and the principal opinions held respecting this property of soils, and also a short description of some experiments recently made at the Royal Agricultural College upon the same question.

Way treated various soils and clays with solutions of ammonia, and with solutions of carbonate, sulphate, and chloride of ammonium. He repeated the same experiments with potash, and with carbonate, sulphate, nitrate, and chloride of potassium. Experiments were also made, though fewer in number, with salts of sodium, calcium, and magnesium. He found that, when solutions of ammonia, potash, or of their carbonates, were filtered through 10 or more inches of soil, these salts were absorbed to such an extent that their presence could not be detected in the filtered liquid till a very considerable amount of the salt-solution had been applied, and the soil had, in fact, become partially saturated. In the case of the carbonates, the carbonic acid, as well as the base of the salt, was generally retained by the soil; but, when the other salts of ammonium and potassium were applied in the same manner, the base only of the salt was absorbed, and the filtered liquid contained the nitric acid, sulphuric acid, and chlorine, united with calcium‡ derived from the soil or clay experimented upon. The salts of sodium were acted on by soil in the same manner as the salts of ammonium or potassium, but the absorption was less energetic. Solutions of caustic lime, and of bicarbonate of calcium, were deprived of their calcium by passing through soil; magnesium was also absorbed from solutions of its salts. In an experiment with a solution of phosphate of sodium, the phosphoric acid was found to be perfectly retained by the soil. A solution of superphosphate was also completely deprived of its phos-

phoric acid by filtering through soil. From all these experiments, Way came to the conclusion that the affinity exhibited by soils was directed solely towards basic substances. Sulphuric, hydrochloric, and nitric acids were apparently not absorbed from their salts; and he was of opinion that the retention of carbonic and phosphoric acids by soil was due only to their forming insoluble compounds with the lime of the soil. The absorption of bases from the solutions of their sulphates, chlorides, nitrates, &c., he considered was brought about through the decomposition of these salts by the lime in the soil; the lime, by combining with the acid, left the base free for absorption.

Way further determined the amount of the absorption in the case of several soils and clays; and, in these experiments, instead of filtering the solution of salt through the soil, a weighed portion of the soil was shaken with a known quantity of the salt-solution, and the extent of the absorption determined from the amount of salt showed by analysis to have disappeared from the solution. This method of experiment has been generally adopted by succeeding investigators, though, as we shall see further on, it is not without its disadvantages.

Before discussing the explanations that have been offered by Way and succeeding investigators of these remarkable properties of soil, it will be well to put the reader in possession, as far as possible, of the facts connected with soil-absorption, which have been gradually accumulated.

All soils seem to possess this property of removing certain bases and acids from solution. The faculty is not confined to one class of soil, but is enjoyed by all the varieties of clay, marl, loam, light sand-soil, and peat-soil. The faculty is not, however, possessed by all soils in the same degree, some soils exhibiting a very considerable absorptive power, while the capabilities of others in this direction are but small. Again, soils differ in their behaviour towards the different classes of salts: two soils that are equal in absorptive power for free ammonia are not, perhaps, equal in their power of absorbing sulphate of ammonium. It was shown, in Way's experiments, that the lime contained in soil took an important part in the action of soil upon sulphates, nitrates, and chlorides—a fact which has been abundantly confirmed by other researches. We can, therefore, easily understand that the presence or absence of lime, and of substances playing a similar part, must materially affect the absorptive power of soil for certain salts.

It must not be supposed that the salts named above, as used in Way's research, are the only substances which soil is capable of absorbing. If sewage or liquid manure be passed through soil, it will be found that nearly the whole of the organic matters held in solution have been removed—the offensive sewage will have become clear water. Here we have a large class of bodies, of which chemists know very little, which soil is clearly capable of absorbing. Again, there can be no doubt that the same action which determines the absorption of potassium or sodium would equally determine the absorption of the rarer alkaline metals—lithium, cesium, and rubidium; or that the salts of the other metals would generally be found to undergo, in contact with a soil containing lime, a similar change to that which sulphate of magnesium and other salts are known to undergo. The list of substances that come under the power of soil-absorption is, in fact, a very large one. Chemists have, however, done wisely in concentrating their study upon the commoner salts of those bodies which are known to be an essential part of plant-food, and are consequently always present in fertile soils. An acquaintance with the action of the soil towards these bodies is most important, and they have naturally received the chief share of attention.

Different bases are not equally absorbed by soil. Few experiments have, however, been made that allow of an exact comparison. Way found that a clay, treated respectively with chloride of ammonium and nitrate of

\* The absorptive action of soil towards the gases of the atmosphere has been but little investigated, and must be passed over for the present.

† *Journal of the Royal Agricultural Society*, vol. xi., p. 313.

‡ In experimenting with a clay derived from soda-felspar, Way found the filtered liquid to contain sodium salts, in place of the calcium salts usually present.



potassium (the salts being used in the proportion of their chemical equivalents), took up a larger percentage of the ammonium than of the potassium, although, at the same time, a greater quantity of the potassium was absorbed. In experiments by Küllenburg,\* in which each salt was also used in its equivalent proportion, the bases were taken up by the soil in the following order, regard being had to the proportions of the equivalent absorbed:—Ammonium, potassium, magnesium, calcium, sodium. The absorptive energy of both soil and clay was thus, from a chemical point of view, greatest for ammonium.

Not only is there this difference with regard to various bases, but experiment has shown that a base is not equally absorbed by soil from its various salts. The hydrate, the phosphate, and carbonate appear to be the salts from which the soil takes up the largest quantity of base; while, from the sulphate, nitrate, and chloride, the soil generally removes a notably smaller quantity.† Of the last three salts, the greatest absorption is usually from the sulphate. Only a few series of experiments have been published in which the behaviour of the same soil towards various salts is fairly compared. It is essential, for such a purpose, that the solutions of the various salts employed should each contain, not the same proportion of salt to water, but the same proportion of *base* to water—that, in fact, each salt should be used in the proportion of its chemical equivalent. It is also necessary that a constant proportion be maintained between the weight of soil and the volume of salt-solution throughout the experiments. The earlier experiments on soil-absorption were not made with this exactness. Küllenburg has recently published an elaborate series of experiments upon one soil, employing each salt in its equivalent proportion, and in five states of dilution. Taking the total absorption in each five experiments as representing the absorptive power of the soil for the particular salt employed, and calling the greatest absorption in each series 100, we have the following as the proportion in which the bases were removed from their various salts:—

*Comparative Absorption from Different Salts of the Same Base.*

(The greatest absorption reckoned as 100.)

	Ammonium.	Potassium.	Sodium.	Magnesium.	Calcium.
Phosphate	100	..	100	..	100
Carbonate	62	..	95	..	85
Sulphate	56	..	72	..	48
Nitrate	..	48	..	58	..
Chloride	45	..	57	..	60

We see that, in every case, the soil retained most base from the solution of the phosphate and carbonate, and that the sulphate stands next highest, except in the case of sodium. Henneberg and Stohmann,‡ experimenting on a garden-soil with salts of ammonium, found the absorption of ammonium from the various salts to be in the following order:—Phosphate, hydrate, sulphate. The absorption from the chloride and nitrate was about equal, and the smallest of any. E. Peters|| found the following order of absorption with salts of potassium:—Phosphate, hydrate, carbonate, bicarbonate, nitrate, sulphate, chloride. Fraas,§ using lysimeters as the vessels for his experiment, found the absorption of potassium salts to be in the order of carbonate, sulphate, nitrate. The only experiments I know of respecting the absorption of phosphoric acid from its various combinations are those by Küllenburg, forming part of the series already referred to. He employed the phosphates of potassium, sodium, and ammonium, and found the proportion of acid removed by the soil from these salts to be as 100 for the potassium salt,

87 for the sodium, and 68 for the ammonium. The whole of this branch of the subject requires further research.

The quantity of a substance which a soil will take up when shaken with a solution of it, is found to depend very much upon the strength of the solution. The following rule has been thoroughly established by a number of observers:—Soils remove the greatest proportion of base from a salt solution when that solution is weak, but they take up the greatest quantity when the solution is strong. Thus, in one of Küllenburg's experiments, 100 grms. of soil took up 0.2360 grm. of potash from a solution of the sulphate, while from a solution of 1-5th the strength the same weight of soil only absorbed 0.0977 grm.; but in the first case only 21.1 per cent of the total potash was taken up, while in the last the absorption was 43.8 per cent. The first part of this law probably holds good only in those cases where, as in the experiments from which it is deduced, the salt is in excess of the soil. A strong and weak solution poured in each case upon an excess of soil would, we conceive, have their salt equally removed, unless, indeed, the stronger solution was so concentrated that it failed to moisten the bulk of soil necessary for its absorption. It is said, by many investigators, that a soil never removes the whole of a substance from solution. This may, perhaps, be true when taken in its absolute sense. The proportion of the salt removed must, however, greatly, depend on the volume of soil employed. If, as in most experiments, the soil is shaken up with four or five times its bulk of liquid, a notable quantity of the salt will remain unabsorbed; but, if the soil be used in excess, and the liquid filtered through it, as in Way's original experiments, the absorption of ammonia, potash, and phosphoric acid will be found to be all but complete, minute traces only appearing in the filtrate; a fact amply attested by the analysis of drainage waters from cultivated fields.

The bases absorbed by soil are, to some extent, given up again when the soil is treated with water. Voelcker found that a soil which had taken up ammonia from solutions of the hydrate, sulphate, and chloride, gave back again half of the quantity absorbed when washed from four to seven times with four times its weight of water, the water remaining in contact each time for several days. E. Peters found that a soil which had absorbed potash, gave up about 1 part of potash to 30,000 of water, but that the potash was much more soluble in water containing carbonic acid. The information we have on this head is very scanty; more experiments are much needed.

A further point that has been noticed respecting the absorptive action of soils is the displacement of one base by another. We have already seen, in Way's experiments, how the absorption of ammonia or potash from their salts is generally attended by the separation of lime from its combination in the soil. In the same way, a soil saturated with ammonia gives up a part of its ammonia when treated with a potassium salt, and potash to some extent replaces the ammonia in the soil. This action, too, has been but little studied, though practically of great importance. Voelcker has pointed out that the beneficial action, upon some soils, of common salt may be owing to the displacement, by the soda, of some of the more valuable constituents of plant-food which the soil contains.

We have now to consider the various explanations which have been offered of these remarkable phenomena of soil absorption.

In Way's first paper, no attempt is made to establish a theory respecting the absorptive power of soils. He plainly states that he considers the operation a purely chemical one, and hints that the absorptive faculty resides in some constituent of clay. He shows, by experiment, that ignition of a soil or clay greatly diminishes its absorbing power; that treatment with strong acid till all soluble matter is removed fails to extinguish the absorptive power, though more or less diminishing it. In his second paper, Way describes a series of experiments with

\* *Jahresbericht der Agrikultur-Chemie*, 1865, p. 15.

† Some soils appear capable of removing about equal quantities of ammonia from solutions of free ammonia and of the three salts just named.

‡ *Jahresbericht der Agrikultur-Chemie*, 1858-9, p. 25.

|| *Ibid.*, 1860-1, p. 9.

§ *Ibid.*, 1861-2, p. 11.



certain artificially-prepared hydrated double silicates, which satisfied him that it was to the presence of such compounds in soils that their absorptive power was to be attributed. Way took a solution of silicate of sodium, and poured it into a solution of alumina in soda; the precipitate that formed was a double silicate of aluminium and sodium. This compound, if treated with lime-water, or a solution of any calcium salt, gave up soda and absorbed lime. The resulting double silicate of aluminium and calcium, if treated with a salt of potassium, gave up lime and absorbed potash. If the sodium, calcium, or potassium salts were treated with a salt of ammonium, they gave up soda, lime, or potash, and absorbed ammonia. In fact, as far as the experiments went, all the principal features which mark the absorption of bases by soil were displayed in still greater energy by these artificially-prepared silicates. The affinity of the silicate of aluminium for bases appeared to be greatest for ammonia, and least for soda; salts of ammonium would decompose any of the other silicates. The silicates of aluminium and calcium had the power of absorbing ammonia gas from the atmosphere. All the silicates possessed a very considerable degree of insolubility.

The explanation of the absorptive action of soils put forth by Way has not met with unanimous acceptance among agricultural chemists. It would be tedious to narrate the views and conclusions of each experimenter, founded as they are in many cases on very limited data, but we may point out the principal divisions of opinion.

Way's opinion, that the absorption by soil was a result of the chemical combination of the substance absorbed with some constituent of the soil, has been, on the whole, generally shared by subsequent experimenters. Some, as Rautenberg and E. Heyden, have supported Way's theory of silicates in its entirety, and have sought to show that the absorptive power of a soil is in proportion to the amount of silicates (decomposable by the alternate action of hydrochloric acid and carbonate of sodium) which it contains. Others, as Knop and Voelcker, while not denying the absorptive power of silicates, have pointed to the hydrated oxides of iron and aluminium as a further and important source of the absorptive energy of soils. Others, again, have experimented with the organic matter of soils, that assemblage of little known-bodies that usually goes by the name of humus, and have shown that it, too, to some limited extent, possesses absorptive powers.

Besides these opinions, all of which take a chemical view of the question, we have the wholly different view put forth by Liebig, who considers that the absorption of the various substances by soil is not in any way a result of chemical combination, but is merely a consequence of the "physical attraction" of a highly porous body. We are referred to the well-known power of charcoal, of removing certain substances from their solution in water, in consequence of which property it is so largely used as a decolourising agent. The ordinary process of dyeing is quoted as another illustration of the same action; where certain organic colouring matters are removed from solution by the vegetable or animal fibre and remain very permanently united to it. We are told there is, in these cases, no chemical combination between the absorbent and the substance absorbed, that the action is the result of mere physical attraction, and that the absorbent powers of soil are nothing more than a manifestation of the same action towards certain inorganic salts. It will be as well to state the view taken by Liebig in his own words\*—

"There can be no doubt that all the component parts of arable soil have a share in these properties, but only when they possess a certain mechanical condition, like wood or animal charcoal; and that this power of absorption depends, as in charcoal, upon a surface attraction, which is termed a physical attraction, because the attracted particles enter into no combination, but retain their chemical properties.

"The term 'physical attraction,' as used here, does not

signify a peculiar attractive force, but merely designates the ordinary chemical affinity, which shows differences of degree in its manifestation.

"From a solution of carbonate of potash or ammonia, or from a solution of phosphate of lime in carbonic acid water, the arable soil will withdraw the potash, ammonia, and phosphoric acid, without any chemical interchange with the constituents of the earth taking place."

We will not at present inquire whether Liebig's view of the subject, or the views of other chemists already quoted, are more in harmony with the facts of the case, but will only just remark that Liebig's description of the attractive power of soil and other absorbents as nothing more than an instance of "ordinary chemical affinity," seems hardly consistent with the other statements he makes regarding this property. Liebig tells us that *all* the component parts of arable soil have a share in this chemical affinity, if only they possess a sufficiently porous texture. Now we can readily understand that an insignificant chemical affinity may be greatly exalted by increasing the surface of the acting body; but that the various constituents of soil, differing as they do so greatly in their chemical nature, should all of them, if they display the necessary amount of surface, exhibit the same chemical affinity for the same substances, is more than a chemist will readily believe. This, however, is what is virtually assumed by Liebig. He tells us, "there is no perceptible connection between the composition of a soil and its power of absorbing potash, ammonia, and phosphoric acid." If mechanical texture is everything, and the chemical properties of the material nothing, the phenomena in question must clearly be physical, and not chemical.

(To be continued.)

## PROCEEDINGS OF SOCIETIES.

### ROYAL INSTITUTION OF GREAT BRITAIN.

*Notes of a Course of Seven Lectures on Electrical Phenomena and Theories.* By Professor TYNDALL, LL.D., F.R.S. (Lecture I.)

1. If two pieces of the same metal (pure zinc or pure platinum, for example), be immersed in water, which has been rendered sour by the addition of a little sulphuric acid, the acidulated water attacks neither.

The ordinary zinc of commerce, being rendered impure by the admixture of other metals, is attacked by the acid. It may, however, be enabled to withstand the acid by covering its surface with mercury. The zinc is dissolved by the mercury, detached from its impurities, and presented to the liquid. This process is called *amalgamation*.

2. If two pieces of two different metals (pure zinc or pure platinum, for example), be immersed in acidulated water, no sensible action occurs *as long as the metals do not touch each other*; but the moment they touch, and as long as they continue in contact, the zinc is attacked by the acidulated water and dissolves, while bubbles of gas rise from the surface of the platinum.

3. This gas when collected proves to have the specific gravity of hydrogen; like hydrogen it also burns in the air. The water, in fact, is decomposed by the touching metals; its oxygen unites with the zinc to form oxide of zinc, while its hydrogen escapes from the platinum.

4. If the two metals be only partially plunged into the acidulated water, it does not matter whether contact occurs *within* the liquid or *outside* of it. The effect, in both cases, is the decomposition of the water, the solution of the zinc, and the liberation of the hydrogen gas.

5. When the two partially immersed metals are connected outside the liquid by a long wire (say of copper) the effect is the same as when they touch directly. In both

\* "The Natural Laws of Husbandry," pp. 67—69.



cases a *circuit* is said to be formed, consisting of the two metals and the liquid. In the case last mentioned the copper wire is said to complete the circuit.

For these experiments a strip of platinum and a strip of amalgamated zinc are employed. The liquid is placed in a glass cell with parallel sides through which is sent a beam of light, and by means of a lens a magnified image of the cell and its two strips is cast upon a screen. The chemical action consequent upon touching the metals, or on completing the circuit with a wire, and its suspension when contact is interrupted, are then very plainly seen.

6. The wire is also said to be the vehicle of an *electric current* which flows round the circuit. It is also called a voltaic current, because the action here described was discovered by the celebrated Italian philosopher, Volta. These terms, however, convey to us, as yet, no meaning. Our sole business during the present lecture is to examine the wire which completes the circuit, and to determine wherein it differs from an ordinary wire.

7. And to enable ourselves to do this effectually, we shall employ an arrangement, or a combination, of zinc and platinum plates and acids, known as a voltaic battery. We shall subsequently analyse this battery, and determine what occurs within it. For the present, as aforesaid, we shall confine ourselves to the examination of the wire which completes the circuit outside the battery.

8. Interrupting the circuit, and immersing the wire in iron filings, it shows no power of attraction over them. Establishing the circuit, on re-immersing the wire in the filings they cluster round it and cling to it. If the wire be raised out of the filings, they form an envelope round it. The moment, however, the circuit is interrupted, the filings fall.

9. If the wire be disconnected from the plates of platinum and zinc, and stretched under and parallel to a suspended bar magnet, no action is observed; but on making the wire, stretched beneath the magnet, form part of a voltaic circuit, the magnet is deflected from the magnetic meridian. This is Ørsted's discovery.

10. To the eye the wire, if tolerably thick, is unchanged by its connection with the zinc and platinum. But if for the thick copper wire a thin platinum wire be substituted it is sensibly heated, and may even be caused to glow brightly. The wire, therefore, must be the vehicle of some power or condition which is competent to produce both magnetic and thermal phenomena.

11. If a naked wire, forming part of a voltaic circuit, be wound round a bar of iron, the power of which the wire was the vehicle is in great part transmitted to the iron, which becomes part of the circuit.

12. But, if the wire be overspun with cotton, or, still better, with silk, this transmission of the power from the wire to the iron bar is prevented. The wire may then be coiled round the bar, while the power is compelled to pass in succession through all the convolutions of the wire. Here the iron bar is not at all in the circuit.

13. But, though not in the circuit, it is powerfully excited by the surrounding wire. Every convolution of the wire evokes a certain amount of *magnetism* in the bar; and, by rendering the convolutions sufficiently numerous, a magnet of enormous strength may be thus generated. This is Arago's discovery.

14. Such a magnet is called an electro-magnet, to distinguish it from ordinary permanent steel magnets. When the circuit is broken, the power of the electro-magnet ceases. It then falls from its highly-excited condition to the condition of ordinary iron.

15. For electro-magnetic purposes, the covered wire is usually coiled round a hollow reel, several layers of coils being sometimes superposed upon each other. In this condition, the reel is called an *electro-magnetic helix*. The iron bar to be magnetised is placed within the helix, forming its *core*. The electro-magnet may be either straight, shaped like a horseshoe, or it may be caused to assume other forms.

16. The smooth bar of iron placed across the ends or

poles of a horseshoe-magnet is sometimes called a *keeper*, sometimes an *armature*, and sometimes a *sub-magnet*.

17. It is not necessary that the convolutions of the helix should be close to the core: a hoop, for example, 1 yard in diameter, round which covered wire is coiled, magnetises an iron bar placed across it at its centre. The magnetised body is here nearly 18 inches from the magnetising-coil. How is the power transmitted from one to the other? is it an action at a distance, or does it require a medium for its propagation? I do not know. The question, at present, profoundly interests investigators.

18. If a covered wire forming part of a voltaic circuit be coiled round an iron bar near one of its ends, there is a propagation of the excitement along the bar towards the distant end. As the coils augment in number, the attractive power of the distant end increases. On undoing the coils, the magnetism gradually falls. The process resembles, more or less, the conduction of heat—the augmentation of the coils answering to the increasing of the temperature, and the undoing of the coils answering to the cooling of the end of the bar.

19. When the end of a cylinder of iron is partially introduced into an electro-magnetic helix, on completing the circuit, a force of suction is exerted upon it, tending to draw it into the helix. Page turned this force to account in the construction of an electro-magnetic engine.

Hollow iron cylinders, which pass freely into the helix, are employed for this experiment, the end only of the hollow cylinder being introduced. When the circuit is completed, the cylinder is suddenly and strongly sucked in.

20. Others have turned to account mechanically the attraction exerted by electro-magnetic cores on bars of iron. The distinguished electro-mechanician, Froment, produced rotatory motion in this way. A series of electro-magnets are so ranged that their poles lay facing each other along the circumference of a circle; and a series of transverse bars of iron are so connected together as to be able to approach the poles in succession, and rotate as a system. When the circuit is established, these bars are attracted, motion being thus imparted to the system. The bars, on arriving at the poles which attract them, suddenly cease to be attracted, the magnetism being temporarily suspended to allow each bar to pass forward, with the velocity impressed upon it, to the next pair of attracting poles. On reaching these, the magnetism is again temporarily suspended. Thus the bars *are never pulled back*; and in this way a continuous motion of rotation is maintained.

21. This rotatory motion can be applied in various ways; it may, for example, be caused to pump water, to saw wood, or to drive piles.

One of Froment's electro-magnetic engines, and its application to pumping and pile-driving, is employed to illustrate this.

22. Sound is one of the physical effects which accompany sudden magnetisation and sudden demagnetisation. An ear placed close to an iron core hears a clink the moment the circuit is established round it. A clink is also heard when the circuit is broken. This is Page's discovery. Employing a contact-breaker (in a distant room, to abolish its noise), the coil may be magnetised and demagnetised in quick succession; the sounds then produced may be heard by several hundreds at once.

A poker of good soft iron, placed within an electro-magnetic helix, and with its two ends supported on wooden trays, produces a very good effect. The sound may be rendered musical.

23. When an iron bar is magnetised, its volume is unchanged, but its shape is altered; it lengthens in the direction of magnetisation. This is Joule's discovery.

24. Joule employed a system of levers to augment the effect, and a microscope to observe the elongation thus augmented. Our method is this:—The iron bar is magnetised by an electro-magnetic helix which surrounds it. Its elongation is first augmented fiftyfold, by means of a



lever; and this motion is applied to turn the axis of a rotating mirror. From the mirror is reflected a long beam of light, which forms an index without weight. The reflected beam may be caused to print a circle of light upon a white screen, and this circle, when the bar is magnetised, suffers a displacement, due to the elongation of the bar. This displacement may amount to a foot or more.

What is the cause of this elongation? The discussion of this question requires some preliminary knowledge.

25. If a sheet of paper, or a square of glass, be placed over a magnet, iron filings, scattered on the paper or on the glass, arrange themselves in lines, which Faraday calls lines of force. Along these lines, the filings set their longest dimensions, and they also attach themselves end to end. A little bar of iron, or a small magnetic needle, freely suspended, sets itself also along these lines of force.

The formation and modifications of the magnetic curves, or lines of force, are shown in this lecture by means of small magnets held between plates of glass and strongly illuminated. Magnified images of the curves are thrown upon a screen about 40 feet distant. The shifting of the curves by the tapping of the glass is plainly visible.

26. We may regard a bar of iron as made up of particles united by the force of cohesion, but still to some extent distinct. When iron is broken, we see crystalline facets on the surface of fracture. In fact, the bar is composed of minute crystals of irregular shape. These, when the bar is magnetised, try to set their longest dimensions parallel to the direction of magnetisation—that is to say, in the direction of the bar itself. They succeed in this effort to some slight extent, and thus produce the minute and temporary lengthening of the bar. This is the explanation of De la Rive; it is, I think, as true as it is acute.

27. Magnetic oxide of iron may be suspended as a powder in water contained in a cylindrical vessel with flat glass ends. Let the vessel be surrounded by a coil of covered wire. Looking at a candle through the muddy liquid, and making the coil part of a voltaic circuit, the candle brightens at the moment the circuit is made. Breaking the circuit, dimness again supervenes. This is due to an arrangement of the particles of suspended oxide, similar to that of the iron filings. They set their longest dimensions parallel to the beam of light, and thus obstruct its passage less. They also attach themselves end to end, and form lines like the lines of filings. This beautiful experiment is due to Grove.

Projecting a magnified image of the end of the cylindrical cell on a screen, and sending through it the beam of the electric lamp whenever the circuit is established, an illuminated disc, 2 or 3 ft in diameter, flashes out upon the screen.

## NOTICES OF BOOKS.

*A Manual of Qualitative Analysis.* By ROBERT GALLO-  
WAY, Professor of Applied Chemistry in the Royal  
College of Science for Ireland, &c. Fifth edition; re-  
written and enlarged; with plate, and other illustra-  
tions. London: John Churchill and Sons. 1870.

THAT a work of this kind should reach, in a few years, a fifth edition, is, in itself, positive evidence that such a book is a really useful one to a great number of students. The new edition before us is materially improved, and also greatly enlarged. Among the additions, we find—Bunsen's Flame Reactions, with a plate of figures of the apparatus; the Detection of the Poisonous Metals and Acid Radicals in the Presence of Organic Matter; Additional Tests for the Detection of the Individual Alkaloids, and More Complete Systematic Methods for the Detection of

these Bodies. The new notation has been adopted; and the book has been divided into three main parts, treating, respectively, on Inorganic Analysis, Analysis of Organic Substances, and on Operations. There is found, almost at the end, an excellent list of apparatus required for qualitative analysis, and appendices wherein the treatment of silver, platinum, and gold residues is fully treated.

*Attfield's Saturation Tables, for Acids and Alkaline Carbonates.* Printed and published (under authority) by H. Silverlock, 92, Blackfriars Road, and Earl Street, Doctors Commons. Price 6d.; mounted on card, varnished, and eyeletted, 9d.

THESE tables are reprinted in large type from Dr. Attfield's valuable work on "General, Medical, and Pharmaceutical Chemistry." They are issued in the most convenient form for constant reference, and will be found useful to chemists and pharmacutists.

## CORRESPONDENCE.

### GRADUATING DIAPHRAGM.

*To the Editor of the Chemical News.*

SIR,—In one of Mr. Suffolk's excellent articles on "Microscopical Manipulation" (vol. xx., p. 291), he mentions one form of graduating diaphragm.

Allow me to supplement this with the following extract from the *Journal of the Franklin Institute*, of February last, in which is described a new and very ingenious contrivance by Mr. J. Zentmayer, so well and widely known from his microscopic stands and lenses, and orthoscopic view lens, made with one kind of glass only, and yet without any chromatic error which can be detected by very delicate tests.

"At the last meeting of the Institute, there was exhibited this exceedingly ingenious arrangement, which is shown in the accompanying cuts, which are taken from

FIG. 1.

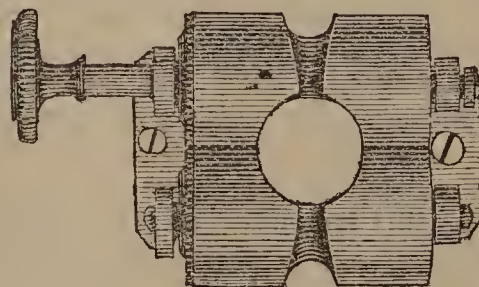
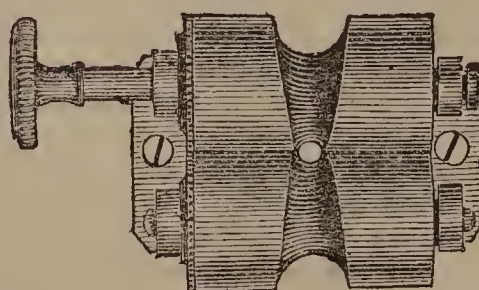


FIG. 2.



photographs; Fig. 1 showing the apparatus with its largest, and Fig. 2 with its smallest opening. To obtain a circular diaphragm which, like the eye, should expand and contract gradually by a continuous change, and yet be made of rigid and unchangeable material, might seem, at first sight, to be an impossibility; but, after all, when the result is accomplished, as in this apparatus, we are surprised as much by the simplicity as by the ingenuity of the means employed.

The wood-cuts almost explain the apparatus of themselves; but we may say, in addition, that it consists of



two cylinders or rollers with parallel axes and surfaces in contact, having similar conical grooves on their surfaces, and fine teeth cut at one end of each, which, gearing together, cause them to rotate in unison.

There is, theoretically, an objection to a diaphragm of this construction, from the fact that its opening will not always be in the same plane—that is, the smallest cross-section of the space between the rollers will not always be equidistant from a plane at right angles to the line of sight and passing through the axes of the rollers. With the larger opening, this smallest section will be nearest to, and with the smaller, further from, such a plane.

In practice, however, this difference is so small as to be entirely unimportant, and may even, in some cases, be turned to advantage."

There are other forms of gradually adjustable stops which have been employed with more or less success, but few involving so many elements of durability and convenience.—I am, &c.,

Franklin Institute,  
Philadelphia, U.S.

HENRY MORTON.

### ANALYSTS' FEES.

To the Editor of the Chemical News.

SIR,—Is it not time that some regular scale of fees be recognised by the body of qualified analytical chemists, to which appeal could be made in cases of dispute? In a recent judgment at the County Court, His Honour considered that "two guineas was a fair charge" for a complete analysis of water to be used for brewing purposes; and a chemist, who parades F.C.S. after his name, and on his card states he is from the Royal School of Mines, was actually found to give evidence that his charge was a guinea and a half!—I am, &c.,

WILLIAM BAKER,  
Associate of the Royal School of Mines.

County Analyst's Office, 46, High Street,  
Sheffield, April 28th, 1870.

### MANUFACTURE OF SULPHURIC ACID.

To the Editor of the Chemical News.

SIR,—I notice in the CHEMICAL NEWS (vol. xxi., p. 200) that Mr. D. B. Hewitt, in his contribution to the sulphuric acid controversy, mentions that Mason's ores require much less nitre per 100 parts of sulphur burnt than do other ores. Would he kindly say whether this applies only to "Mason's" ores? or does it take in all Spanish and cupreous ones? The reason for one kind requiring so much less than another would also oblige.—I am, &c.,  
O. V.

### DOUBLE ARSENIATE OF MAGNESIA AND AMMONIA.

To the Editor of the Chemical News.

SIR,—I read with interest the note on the double arseniate of magnesia and ammonia by Mr. Frederick Field, F.R.S., in the CHEMICAL NEWS (vol. xxi., p. 193). Mr. Field, however, slightly misunderstands the conclusion of mine, to which he draws attention in his paper. By the "excess of water" which is driven off between 100° and 110° I mean the excess above the 1 equivalent, not, as Mr. Field understands, the whole of the remaining water.

Experiments that I have made seem to indicate that this equivalent is retained, even after prolonged heating at a temperature of 120° C. As to drying the precipitates from the various estimations at a temperature of 100° to 110°, I followed precisely the instructions given in Fresenius's "Quantitative Analysis;" drying at the above

temperature is there advised, the dry arseniate at the same time being represented as retaining its equivalent of water.—I am, &c.,

E. W. PARNELL.

Runcorn, May 3rd, 1870.

### MISCELLANEOUS.

Fluids in Crystals.—Spectrum analysis has been applied by Vogelsang and Geissler to the difficult question of determining the chemical nature of the fluid found inclosed, in minute quantity, in the cavities of certain quartz-crystals. Fragments of quartz were placed in a small retort which was connected with an air-pump and exhausted; then, by the application of heat, the quartz decrepitated, and the evolved vapour was examined in a Geissler-tube. The presence of carbonic acid was thus abundantly proved, and this was confirmed by the turbidity which it produced in lime-water.

Death of the Dean (Doyen) of the French Professors.—We learn, from the *Moniteur Belge* of the 30th ult., that Dr. Lordat, Honorary Professor of the University of Montpellier, has just died there, at the advanced age of 98 years. The deceased took the degree of M.D., at the university just named, in 1797, and for a series of years he occupied the post of Doyen de la Faculté de Médecine, and was among the best teachers and the most expert medical practitioners that University has possessed. The deceased resigned from his active duties some ten years ago, retaining the titles simply honorary. Dr. Lordat was a staunch supporter of the doctrine of *vis vitalis*, and adverse to the explanation of the phenomena of life by merely physical or chemical action. He has published a great many excellent medical works, and was (not only at Montpellier, but in the whole of Southern France) a physician whose aid and advice were esteemed of great value. His valuable library, including that of the late *savant*, Barthez, has been bequeathed by him to the Medical Faculty of the University above named.

Working Under High Pressure.—We glean the following particulars from the reports of the works at the Illinois and St. Louis Bridge:—At a depth of 85 feet, it was first noticed in the east air chamber that the flame of a candle would immediately return when blown out by the breath, sometimes after an interval of a few seconds, and that repeated blasts of the breath were required to finally extinguish the light. This phenomenon is not observable at the present depth of the west air chamber (over 71 feet). The flame of the candle is, perhaps, twice as large as in the normal atmosphere, but such large quantities of carbon (particles of lamp-black) and smoke are emitted as to constitute a serious annoyance, requiring several expedients to get rid of it. Two curious accidents from fire have occurred in the east chamber, one of which caused serious injury to one of the workmen. This man was engaged in passing out cement from the air-lock into the air chamber, when his coat skirts came in contact with a candle in the lock, and, although his garments were woollen, one leg and arm were badly burned before the flames could be extinguished. In the other case, the under clothing of the man saved him from injury, the external ones about the waist being badly burned, and only extinguished by his fellow workmen throwing him down into a pool of water in the bottom of the chamber. Candles are the only lights permitted within the air chambers, being less liable to cause accidents. About 4 atmospheres are now contained within the east air chamber, the pressure being about 44 lbs. above the normal one. Within the last few days, several of the workmen employed in filling the east chamber with concrete have been severely attacked with paralysis. No death from this cause occurred until after the depth worked in was over 95 feet; three or four have occurred within the past ten days, which were believed to have been superinduced



by the severe air-pressure. At the coroner's inquest held on the last one, two distinguished physicians present attributed the abnormal developments exhibited by *post mortem* examination to diametrically different causes—one to a too sudden change from the normal to the dense atmosphere, and the other to the too rapid transition from the dense to the normal pressure. Neither of these is correct, as the lock-tenders have never been thus affected, while they are alternately under the pressure fifteen to twenty times during a watch of two hours while passing the workmen in and out. It is probable that the duration of time to which the system is subjected to the unnatural pressure is the chief cause of the paralysis induced, as many hundreds, indeed thousands, of visitors have entered, and remained in the chamber from thirty minutes to an hour and a half, without one of them being thus affected. The chief engineer forbade the workmen remaining longer than one hour at a time in it. After thus working for four days, the workmen themselves protested and petitioned against this; and two-hour shifts have been since instituted, in consequence of their expressed desire.

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

*Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

*Comptes Rendus des Séances de l'Académie des Sciences, April 25, 1870.*

This number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

**Researches on New Platinic Compounds Derived from the Phosphuretted Bases.**—A. Cahours and H. Gal.—This paper contains the record of researches on the results of the reaction of bichloride of platinum upon triethyl-phosphine. The authors observe that compounds are formed the composition and constitution of which are exactly alike, although their properties differ considerably. The memoir is too lengthy to enter into full details on this subject here; we therefore propose to give to our readers a full translation of this paper at a future day.

**Utilisation of the Secondary Products obtained by the Manufacture of Chloral on the Large Scale.**—Dr. A. W. Hofmann.—The main gist of this paper is that, in Germany, a very large quantity of hydrochloric ether is prepared as a by-product of the preparation of chloral, and the author applies this and other by-products of this manufacture for the preparation of ethyl-ammonias. The author's paper in this number contains a large number of quotations of the results of his labours published in the *Proceedings of the Royal Society*, and elsewhere in this country.

**Geological Microzymas of Different Origin.**—A. Béchamp.—The author first alludes to the well-known fact, that perfectly pure carbonate of lime—viz., white marble, Iceland spar—has no action whatever upon starch or sugar solutions. He next states that carbonate of lime from different geological formations contains, invariably, living organisms, termed by him microzymas, and that to these microscopically-small beings is due the fact that different kinds of carbonate of lime produce, when in contact with solutions of cane sugar or starch paste, the phenomena of fermentation. The author not only finds these organisms in comparatively recent formations of carbonate of lime, but even in the oolitic limestone and the calcarous tuffa. The author's very lengthy memoir contains the record of his experiments, into the details of which we cannot enter here any further.

**Experimental Researches on the Length of the Duration of the Electric Spark.**—Drs. Lucas and Cazin.

**Electric Currents.**—A. Trève.

**Latent Heat of Ice, as Deduced from the Experiments of Laplace and Lavoisier.**—E. Renou.

**Formation of Drops from Liquids.**—Dr. Duclaux.—Reserved for full translation.

**Thermal Researches on Iodic Acid.**—A. Ditte.—An algebraico-physical paper.

**Thermal Researches on the Different States of Aggregation of Sulphur.**—Dr. Berthelot.—The chief results arrived at by the author are—The transformation of dissolved octahedral sulphur into the insoluble variety, under the influence of direct sunlight, is accompanied by an evolution of heat equal to 12.8 calories to the gramme; the transformation of molten ordinary sulphur into insoluble sulphur is also accompanied by an evolution of heat. The transformations alluded to are promoted by the action of direct sunlight.

This number contains a series of papers on subjects, strictly speaking, belong to astronomy, but, among these, not a few bear upon the spectroscopical observations of the sun's protuberances. Although, strictly speaking, only of local interest, we may not neglect to notice a paper on the—

**Agricultural Terrain of the Sologne.**—Dr. Mazure.—A paper highly praised by M. Boussingault and others as an excellent pattern for the study of the soils under tillage in its different physical, chemical, and cosmical relations.

**The Meteor of the 19th of April last.**—Dr. Chapelas.—A full account of the results of accurate astronomical observations on this subject, and description of the phenomena accompanying this apparition.

*Monatsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin, January, 1870.*

This number, just published, contains no papers at all relating to physical sciences.

*Revue Universelle des Mines, de la Métallurgie, et des Travaux Publics de Belgique, No. 1, 1870.*

This volume contains the following original papers and memoirs relating to chemistry and allied sciences:—

**Best Methods of Agglutination of Mineral and other Fuel.**—A. Habets.—A very extensive and exhaustive monograph on this important subject, especially for those countries where coal mining is carried on, and where, consequently, coal-dust and small coal abound.

**Motion of Permanent Gases through Pipes.**—Dr. Grashof.—A mathematico-physical essay.

**Ventilation of Mines, and the Application, for that purpose, of Ventilators Worked Centrifugally.**—E. Harze.

*Annales du Génie Civil, March, 1870.*

This number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

**On Warming and Ventilation.**—C. Tronquoy.—First portion of a valuable paper on this subject, illustrated with a large number of engravings.

**Alunite of Mont-Dore.**—J. Gonnard.—The mineral alluded to is met with in a remarkable (geologically) district of France, known as le Puy de Dôme. The material is a greyish, or bluish grey, compact, but rarely crystallised, mass, containing, here and there, beautiful crystals of native sulphur interspersed. The seam, or layer, of this mineral, which is now dug up for the purpose of the manufacture of alum, has a thickness of 100 metres, by a width of from 50 to 60. This alunite contains, in 100 parts—Sulphuric acid, 39.1; alumina, 46.5; potassa, 8.5; water, 5.9. The crystalline alunite of Tolfa (Papal States) contains, in 100 parts—Sulphuric acid, 35.50; alumina, 39.65; potassa, 10.02; water, 14.83. The alunite of Mont-Dore yields, on being heated in closed vessels, earthenware or clay retorts, a small quantity of very pure sulphur.

*Journal de Pharmacie et de Chimie, April, 1870.*

This number contains the following original papers:—

**Chemical Equilibrium between Carbon, Hydrogen, and Oxygen.**—Dr. Berthelot.—This paper is the amplification of a shorter paper on this same subject, already quoted from the *Comptes Rendus*.

**Constant-Acting Galvanic Battery with One Liquid.**—M. Fignier.—Illustrated with several woodcuts, indispensable to the proper understanding of this paper.

**Detection of Logwood Colour in Wines, by means of Neutral Acetate of Copper.**—J. Lapeyrère.—The author states that, while studying some of the properties of the colouring principle of logwood (*bois de Campêche*), he found that the hematine it contains yields a sky-blue colour with salts of copper. In order to apply this test to wines for detecting if they are doctored with logwood, it is only necessary to place strips of good filtering paper, Swedish being preferred, into an aqueous solution of neutral acetate of copper, and, after drying, use one of these slips to test the wine suspected to be adulterated with logwood colour, by dipping the paper into the wine; and, on removing it from that fluid, care should be taken to cause the adhering drop of wine to flow backwards and forwards over the paper, which is next rapidly but carefully dried. If the wine be as it naturally ought to be, the colour exhibited after drying will be grey, or rose-red greyish; but, if logwood is present, the tinge will be distinctly sky-blue.

**Sulphuretted Water.**—Dr. Gossart.—The author states that a coal-mining company at Meurchin (Pas-de-Calais), while sinking a



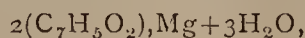
shaft, met, at 250 metres' depth, with water of a temperature of from 43° to 50°, and giving off a most intense foul smell. This water, moreover, came up in such prodigious quantity as to impede the progress of the works for a time. The water is perfectly clear; sp. gr., 1.0021; odour, strongly sulphurous; deposits sulphur on standing. Composition of this water, calculated for 1 litre:—*Gaseous matters*—Sulphuretted hydrogen, 17.48 c.c.; carbonic acid, 6 c.c.; nitrogen, 23.44 c.c.; sulphide of calcium (and the following in grms.), 0.011; sulphate of lime, 0.624; sulphate of potassa, 0.081; sulphate of soda, 1.258; chloride of magnesium, 0.275; chloride of sodium, 1.105; silica, 0.028; fluorine, a trace. *Bituminous matter*, 0.013; total solids to the litre, 3.395 grms.

*Moniteur Scientifique*, No. 320, April 15, 1870.

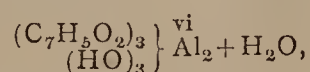
This number contains the following original papers relating to chemistry and collateral sciences:—

**The Increasing Expense of Living (le Renchérissement de la Vie).**—G. Ville.—Under this title, is published here, *in extenso*, a most interesting public lecture, given at the Sorbonne, wherein the author treats, in reality, on scientific agriculture and the application of manures, as well as of improved cultivation processes, so as thereby to render, not only the crops better in quality, but also to increase the quantity of the produce. This interesting paper contains a large amount of very-generally useful information, but its great length, and the fact also, that, the lecture largely bears on political and domestic economy, prevents us entering into further details.

**Composition of some Metallic Benzoates.**—F. Sestini.—The author describes ten inorganic salts of benzoic acid, among which the following are most remarkable:—Benzoate of magnesia—



prepared by direct combination of the acid with the base, and evaporated over sulphuric acid; this salt crystallises in oblique prisms, but, when evaporated by heat, it forms a white mass, exhibiting lamellar structure; 1 part of this salt requires 22 parts of water at 35° for solution, which is acid to test-paper. Benzoate of alumina—



obtained by double decomposition; very soluble in water; solution acid to test-paper; but a basic salt. Benzoate of zinc,  $(C_7H_5O_2)_2 Zn$ , crystallises either in prisms or in lamellar shape; this salt is more soluble in cold than in hot water; solution is acid to test-paper, and is precipitated by alcohol. Benzoate of cobalt is a beautifully peach-blossom coloured substance. Benzoate of copper is a salt very difficultly soluble in cold water; crystallises, from its boiling-hot solution, in rhomboidal shape, exhibiting a bright blue colour.

**Chloride and Iodide of Propionyl.**—F. Sestini.—Chiefly a tabulated series of formulæ, and the boiling-points of some twenty different compounds.

**Researches on Oxylic Compounds.**—P. de Clermont.—This very lengthy paper is divided into the following sections:—Hydrate of octylen,  $C_8H_{18}O$ ; chlorhydrate of octylen; bromhydrate of octylen; iodhydrate of octylen; acetate of octylen; octylic glycol,  $C_8H_{16}(OH)_2$ ; diacetate of octylen; chlorhydrine of octyl-glycol; octylenic aceto-chlorhydrine; oxide of octylen. All these bodies are described, with their mode of preparation and properties, at great length.

**Mechanical Physiology.**—M. Marey.—Under this title, the author describes, at great length, and illustrates with engravings, a very interesting series of experiments on the flight of birds and insects.

**On the Saccharate of Hydrocarbonate which Purifies and Saccharises, as alleged by MM. Boivin and Loiseau.**—Prof. Dubrunfaut.—In the first place, we are bound to reproduce the French title in full, in order to justify the translation—"Sur le Sucrate d'Hydrocarbonate Dépurant et Sucratant de M.M.," &c. The author criticises very sharply, in this, as yet, preliminary paper, a subject of some importance; but the main point appears to be that the purifying and sucifying hydrocarbonate does not exist. The author promises an exhaustive paper on this subject.

*Les Mondes*, April 21, 1870.

**Oxyhydrogen Illumination for Public and Private Use.**—Rev. F. Moigno.—The author gives, in this paper, an account of the works proposed to be executed by a company in Paris, on an, as yet, limited scale, with the view to test thoroughly the value of the application of oxygen to replace atmospheric air as supporter of the combustion of gas.

**Discovery of the Most Ancient Monument of Paris.**—Without entering into details which our readers may have seen from the daily papers, concerning the discovery recently made, at Paris, of a very well-preserved amphitheatre of Ancient Lutetia, we only desire to rectify an error some of our daily contemporaries have made on this topic, by stating that the building alluded to is of later date than the Thermæ of Julian, in the Cité of Paris. The fact is that the Amphitheatre is at least two centuries older than the Thermæ.

**Metallic Areometers.**—M. Leroy.—Metallic areometers are not, as we all know, very common, and would not certainly suit for such purposes as, for instance, taking specific gravities of acids and alkaline fluids; but it is not generally known that, as here reported, the almost exclusive use of glass areometers for taking the specific gravity of neutral liquids, alcohol, saccharine fluids, &c., is, in reality, due (at least, for France), to a contract entered into by the late Gay-Lussac and M. Collardeau, the maker of glass areometers; Gay-Lussac under-

taking, for a consideration, to denounce the use, and bring into disrepute, the metallic areometers, which in this paper are highly eulogised and recommended.

**Inexplosible Steam Multiplicator.**—M. Petit-Pierre.—The author describes, and illustrates by a woodcut, a very useful contrivance for obtaining dry steam (superheated) accompanied with a saving of fuel. Those of our readers who might desire to have full particulars on this excellent subject, should write to the author, 41, Rue Dulong à Batignolles, near Paris; or to M. Bonnaterre, 11, Rue Gaillon, Paris.

*Cosmos*, April 23, 1870.

**Death of Dr. Unger.**—This celebrated botanist was found dead in his bed at Grätz (Austria). According to some accounts, the deceased was killed by burglars, by means of strangulation; but, curiously enough, all valuables in his bed-room were untouched. The committee of the medical faculty of Vienna, which was called in by the police to explain, if possible, the cause of the doctor's death, unanimously state that his death was due to natural causes.

**Artificial Production of Ice in India.**—Dr. Janssen relates that, in many parts of the Indian Continent, the natives dig shallow pits in such localities which are quite freely open to the sky and distant from trees. The pits are lined with straw, and upon the straw are placed dishes (made of a very porous earthenware) filled with water. During the calm and clear nights prevailing during the period from November to the end of February, the water placed in the dishes freezes, yielding a solid cake of ice, while the temperature of the air is +10°. Dr. Janssen has investigated this curious subject experimentally, and has found that the freezing is principally due to the radiation during the night; but the evaporation of the water, aided by the porosity of the earthenware employed, is not to be overlooked, at the same time.

**Studies on Grapes; the Juice they contain, and Vinification.**—Dr. le Canu.—This rather lengthy paper contains the record of some very important facts relating to the manufacture of wine from grapes.

**Machine for Peeling Potatoes.**—The Rev. Liévin Bouteca.—The author, Director of the Convent of St. Joseph-de-Nôtre-Dame-de-la-Trappe, at Forges (Hainaut, Belgium), has contrived a machine, by the aid of which one man can peel, without very hard work, from 250 to 450 kilos. of potatoes in an hour's time. After the tubers have been first roughly washed, they are placed in a cylinder, pierced with holes in such a manner as to form a rasp; the bottom of this cylinder is made movable, and also pierced with holes as just stated. Motion is imparted to the bottom of the cylinder by suitable means; and, by this means, the potatoes, by the friction against each other and the rasps, are rapidly peeled, while a jet of water is at the same time applied to wash the peelings down.

*Revue Hebdomadaire de Chimie*, April 14, 1870.

**Preparation of the Extracts from Dye-Woods.**—C. Mène.—This paper, too lengthy for any useful abstraction, describes the important improvements made in this branch of industry in France.

**Chain-Pump for Work in Thickish Liquids, such as Molasses, Treacle, Tar.**—MM. Tesse du Rivaux.—This description is illustrated with a woodcut. The makers of this very useful contrivance reside at Cuernes (Pas-de-Calais, France).

**Revivification of the Oxides of Iron Employed in Gas Purifiers by means of Steam.**—C. Mène.—From the author's description, it appears that, at the Vaise station of the Lyon gas-works, the following process is applied for regenerating the oxide of iron:—The oxide of iron, saturated with sulphur as it is taken from the purifiers, is placed in a tank made of iron, which, after having been filled, is hermetically closed. A pipe from a steam-boiler admits steam in the middle or bottom of the tank; while at the top thereof another pipe leads into the chimney-stalk of the boiler-furnace, carrying off the sulphuretted hydrogen resulting from the action of the steam (low pressure) upon the sulphide of iron. Actual decomposition of water takes place in this process, its hydrogen combining with the sulphur, and its oxygen reproducing the peroxide of iron. The great advantage of this process is the very considerable saving of time and the space required for exposing the peroxide to the action of the air; a slow process.

**Titration of Chlorine and Eaux-de-Javelle Liquors.**—A. Bastuert.—After some preliminary remarks upon the extensive application of chlorine preparations for bleaching vegetable fibres, the author describes, in the following manner, the modifications he has brought on to the Gay-Lussac method of chlorine estimation. The instruments used are:—A burette, graduated, not into cubic centimetres, but into divisions corresponding to the degree (what degree is not stated, but it may be according to Baumé's areometer) of the liquid to be operated upon; a measure-glass, called a saturation vessel; a suitable measure for taking the required quantity of test-liquid; a bottle of test-liquor (blue liquid, indigo solution). In order to test the bleaching liquor, the measure-glass is filled with blue liquid. After this has been done, that liquid is poured over into the saturation vessel; and, next, the burette is filled up to the mark with the chlorine solution, which is then poured cautiously into the blue liquid until the colour of the latter disappears. By this means, the whole operation is reduced to two measurements, which may be executed by workmen. We regret that the author of this paper has not more fully and clearly explained the apparatus, as well as the operations intended to be performed. The paper is not at all clear.



*Neues Jahrbuch für Pharmacie, von Dr. F. Vorwerk, February, 1870.*

This number contains the following original papers and memoirs:—

**Chemical Constituents of the Asparagus Berries.**—H. Reinsch.—Our readers are all acquainted with the vegetable known as asparagus; they also know that, when this plant comes to full development towards the latter end of the summer, it produces berries of the size of medium green peas, of dark red colour, and a waxy appearance. The author has instituted some experiments, and investigated the nature of these berries, which enclose four black-coloured, somewhat angular-shaped, internally greenish seeds, made up of a horny material, like raw coffee, but far more tough than the latter, because, after drying, the asparagus seeds cannot be pulverised in a mortar. The author has collected a sufficient quantity of the berries to try whether the seeds might be used as a substitute for coffee. For this purpose, the berries are bruised, and left to ferment for some days. The seeds are separated from the pulpy mass by means of a sieve; next washed with water; dried and roasted in the same way as coffee. The author made a mixture of equal parts of coffee and asparagus seeds, which, after roasting, was not, when infused with boiling-water, in the least distinguishable from excellent coffee. The berries contain a large amount of glucose (grape sugar), and may, consequently, be used for the production of spirits, after fermentation. Of far more importance, however, may be a substance which the author has discovered in the berries—viz., the pigment contained therein, and named spargancine—a yellowish red colouring matter, soluble in alcohol and ether, and yielding, with salts of lead and alumina, yellow-coloured pigments. The author's researches on this subject are not complete, owing to want of sufficient raw material. As regards the horny seeds they contain oil, grape sugar, a peculiarly bitter principle, spargine, some resin, and a colouring matter. It appears that the crop of asparagus berries (at least, in the neighbourhood of Nürnberg, Bavaria, where the author resides) is very large; a single plant yielded more than  $\frac{1}{2}$  lb. of berries.

**Estimation of Organic Matter in Spring Water.**—Dr. H. Trommsdorff.—This very lengthy essay treats chiefly on the best methods of applying permanganate of potassa, preferably in alkaline solution, to estimate the quantity of organic matter present in water.

**Solanine in Potatoes.**—P. Vieth.—The author states that a quantity of potatoes, originally of very good quality, and kept during the past winter in a cellar, after having been cooked, were found to be uneatable, in consequence of causing a very bitter taste and burning sensation in the throat. On investigation, these tubers proved to be (externally, at least) quite healthy; they had been excluded from light, and kept from a too high temperature; exhibited no symptoms of sprouting. On being cut through, it was found that, internally, they had become, in part, greenish coloured. The author removed this greenish coloured layer from several of the tubers, dried the substance, powdered it, and treated it, first, for some days, with dilute sulphuric acid. This liquor was first boiled, next precipitated with ammonia; the ensuing precipitate was washed with ammoniacal water, until it ran off colourless; the precipitate was dried and exhausted with boiling alcohol. On evaporating this solution, a yellow-coloured horny substance remained, exhibiting a distinctly crystalline appearance when seen under the microscope. When moistened with sulphuric acid, this substance became, first, orange-coloured, next violet, and at last blue, reactions sufficiently indicating the presence of solanine. Our readers are aware that the potato, *Solanum tuberosum*, in the green stalks, leaves, and seeds, always contains solanine to some extent.

*Journal für Praktische Chemie* (double number), Nos. 2 and 3, 1870.

These numbers contain the following original essays and papers:—

**Isomorphism of Various Composed Bodies.**—A. Kenngott.—This paper is so full of formulæ, relating to the atomistic constitution of native minerals (chiefly silicates), that it is not possible to give any abstract of the contents.

**Contribution to our Knowledge of Epichlorhydrine.**—Dr. F. O. Pazschke.—This lengthy essay is divided into the following chapters:—On the identity of dichlorhydrine from glycerine and from epichlorhydrine; on the action of neutral sulphate of potassa upon epichlorhydrine; disulpho-glycerinate of potassa; disulpho-glycerinate of baryta; disulpho-glycerinate of lead; anhydrous disulpho-glycerinate of baryta; disulpho-glycerinate of silver; formation of disulpho-glycerinic acid from chlormethyl-oisethionate of soda and neutral sulphite of soda; action of cyanide of potassium upon epichlorhydrine. The author summarises the results of his researches as follows:—(1) The dichlorhydrines from glycerine and epichlorhydrine are identical; (2) by the action of neutral sulphite of potassa upon epichlorhydrine, there is not formed the acid,  $C_3H_5O.SO_2OH$ , but, instead thereof, disulpho-glycerinic acid is obtained; (3) chlormethyl-oisethionate of soda and neutral sulphite of soda also yield disulpho-glycerinic acid; (4) cyanide of potassium and epichlorhydrine yield, by double decomposition, epicyanhydrine, which, in its turn, may be converted into epichlorhydrine-carbonic acid.

**Some New Compounds of Decomposition of Diabenzonic Acid.**—P. Griess.

**Sulpho-Cyanogen Compounds.**—Dr. L. Glutz.—This essay is divided into the following sections:—Behaviour of sulphocyanide of ethyl with concentrated hydriodic acid; derivatives of sulphocyanide of ethyl; rhodan-ethyl-sulphin-chloride; nitrate of rhodan-ethyl-sulphin-oxide,  $(C_2H_4SCN)SH_2ONO_2 + \frac{1}{2}H_2O$ ; rhodan-ethyl-sulphin-rhodanide,  $(C_2H_4SCN)SH_2SCN$ ; free rhodan-ethyl-sulphin-oxyhydrate,  $(C_2H_4SCN)SH_2OH$ .

**Composition of Chabacite.**—A. Kengott.—This lengthy paper contains, first, a review of the various results of analysis of the mineral

called chabacite, as obtained by different authors, and next, a lengthy discussion as to the proper formula to be assigned to this mineral, which is, to some extent, a kind of *bête noire* of mineralogical chemists; because, although it has been analysed by the most competent hands, and the mineral is crystalline, there are great discrepancies in the results. Chabacite contains, in 100 parts, according to some analysts:—Silica, 51.46; alumina, 17.65; lime, 8.91; soda, 1.09; potassa, 0.17; water, 19.66; peroxide of iron, 0.85.

**Chemical Constitution of Uric Acid and its Derivatives.**—H. Kolbe.

**New Derivatives of Acetone.**—Dr. Glutz.—As yet only a preliminary notice.

**Phenyl Ether.**—W. Hoffmeister.—When sulphate of diazobenzol is mixed with excess of phenol, nitrogen is evolved, even at the ordinary temperature of the air, while there is obtained, at the same time, a thick oily fluid, exhibiting an agreeable aromatic smell. When this liquid is treated, first, with excess of caustic soda, and next rectified by distillation with steam, an oil is obtained boiling at from 250° to 255°, which has the same composition as phenyl-ether, and becomes solid on cooling, fusing again at 28°.

**Preparation of Acetones by the Aid of Mercurio-Diphenyl.**—R. Otto.—Only a preliminary notice.

## NOTES AND QUERIES.

**Gas Furnace.**—Will some of your readers, from experience, inform me which is the best gas furnace for combustions? I believe there is one which is an improvement upon Hofmann's.—B. C. J.

**Water Analysis.**—Can any of your accomplished correspondents give me a simple practical method of analysing water. Dr. Moffat mentions, in his advertisement in the CHEMICAL NEWS, that he has enquired into the matter; where is his method to be found?—H. O.

**Pasting Labels on Sheet-Iron.**—What kind of gum or paste is used for sticking printed labels on Birmingham and Sheffield wares? Labels are frequently attached to the unpolished portions of hatchets, scythes, and other edge tools. Such adhesive material would suit my purposes.—T. M.

**Crushing and Making Sugar.**—A Queensland colonist (a reader of the CHEMICAL NEWS), living in the sugar-growing district, wishes information on the machinery requisite for crushing and making sugar grown on his own farm and on the small holdings around, which are from 8 to 10 acres each. Economy and simplicity are special requisites.—J. C., April 27th, 1870.

## MEETINGS FOR THE WEEK.

- MONDAY, 9th.—London Institution, 4.  
— Geographical, 8.30.  
— Royal Institution, 2. General Monthly Meeting.
- TUESDAY, 10th.—Institution of Civil Engineers, 8.  
— Royal Institution, 3. Prof. Blackie, "Principles of Moral Philosophy."  
— Photographic, 8.  
— Ethnological, 8.
- WEDNESDAY, 11th.—Society of Arts, 8.  
— Geological, 8.  
— Microscopical, 8.
- THURSDAY, 12th.—London Institution, 7.30.  
— Royal, 8.30.  
— Royal Society Club, 6.  
— Zoological, 8.30.  
— Royal Institution, 3. Prof. Tyndall, "On Electricity."
- FRIDAY, 13th.—Quekett Microscopical Club, 8.  
— Astronomical, 8.  
— Royal Institution, 8. Rev. Canon Mosely, "Descent of Glaciers."
- SATURDAY, 14th.—Royal Institution, 3. Prof. Grant, "Astronomy of Comets."  
— Quekett Microscopical Club. Excursion to Carshalton. To Meet at London Bridge Station (South London Line) at 2 o'clock.

## TO CORRESPONDENTS.

**Chemicus.**—Any prism will do, but it should be mounted as a spectroscop.

**W. F. K. Stock.**—Consult the Blue Book, reviewed in Nos. 542 and 543 of our journal. You can obtain a copy at the Queen's printers, Messrs. Spottiswoode and Co.

**A Student.**—(1) Apply at the South Kensington Museum for information respecting Government Examinations; but, we are sorry to say, there is no examination for analytical chemists. (2) The Editor has a book in the press.

**T. Walsh, M.D.**—Several of Faraday's lectures at the Royal Institution were taken down in shorthand, and printed *verbatim* in the pages of the CHEMICAL NEWS; but these are in the early numbers, some of which are out of print, and can only be occasionally got by purchasing a complete set. A second-hand set can be heard of by applying at our office.



# THE CHEMICAL NEWS.

VOL. XXI. No. 546.

## THE ESTIMATION OF CHLORINE IN NATURAL WATERS.

By THOMAS P. BLUNT, B.A. (Oxon.), F.C.S.

It may not be generally known that the chlorine in natural waters may be estimated with great readiness and very considerable accuracy by applying to the original water a slight modification of the ordinary volumetric process. The method adopted is as follows:—

A volumetric solution of nitrate of silver is prepared, of the usual strength, by dissolving 170 parts of pure, dry crystals of nitrate of silver in 10,000 parts of distilled water, the strength of the solution being verified in the usual way, by titration with a weighed quantity of chloride of sodium, the final reaction being marked by the use of neutral chromate of potassium.

This standard solution is delivered from a 50-grain graduated pipette, made of narrow glass-tubing, and drawn to a fine point, so that perfect control may be maintained over the flow of the liquid by increasing or relaxing the pressure of the finger. The experiment is made upon 1000 measured grains of the water, to which have been added 3 or 4 drops of a saturated solution of neutral chromate of potassium. The completion of the reaction is marked with great sharpness, by the change from clear yellow to a reddish tinge; and the results are very satisfactory, as the two estimations appended will show. In both of them the chlorine was first determined volumetrically, by the method given above, and subsequently a gravimetric estimation was conducted upon one imperial pint, which was evaporated to a small bulk, slightly acidified with nitric acid, and precipitated with nitrate of silver. No. 1 was a very pure spring-water, obtained from a remote part of the Welsh hills. No. 2 was procured from a town well, proved by a previous analysis to be contaminated with animal matters.

	Volumetric estimation of chlorine per gallon.	Gravimetric estimation of chlorine per gallon.
No. 1 ..	0.994 ..	0.8904 ..
No. 2 ..	7.455 ..	7.4160 ..

The process here given may prove of some interest, on account of the connection which has been lately traced between the quantity of chlorine in a water and its liability to sewage-contamination—a point strongly brought out by the "Report of the Commissioners for the Prevention of the Pollution of Rivers," quoted in a recent number of the CHEMICAL NEWS.

## ON THE LAWS WHICH REGULATE THE DIVISION OF A BODY BETWEEN TWO SOLVENTS.

By MM. BERTHELOT and JUNGFLAISCH.

It is frequently necessary to extract a body which has been dissolved in a liquid, by stirring into the latter another which does not combine with it, and whose action is, therefore, purely physical. Such means are frequently used for extraction, and even estimation, of bodies held in suspension in other liquids.

The action of the following bodies has been studied:—Iodine and bromine, in the presence of water and of sulphide of carbon; succinic, malic, tartaric, oxalic, acetic,

benzoic, sulphuric, and chlorhydric acids, in the presence of water and of ether.

All bodies capable of exercising chemical reaction were carefully excluded from our experiments; and the usual mode of operation was as follows:—The body under treatment was dissolved in one liquid, a certain volume of another was then added; and the whole received a vigorous and prolonged stirring, the vessels being kept at one temperature by means of a water-bath. The body in solution was estimated from time to time, until fixed results were obtained, which sometimes required one or two hours, and the amount was then estimated in each of the superincumbent liquids.

*The Co-Efficient of Division.*—A body simultaneously brought in contact with two solvents, in each of which it could be separately dissolved, never dissolves wholly in one to the exclusion of the other. Whatever may be the solubility of the body in question in one of these solvents, and whatever may be the excess of that solvent, the body is always divided between the two solvents.

Quantities dissolved by the same volume of two liquids remain in one constant relation between them. We will call this relation the co-efficient of division; it is independent of the relative volumes of the two solvents, but dependent on concentration and temperature. The following examples, cited from our numerous experiments, will be sufficient to establish this law.

### SUCCINIC ACID, WATER, AND ETHER, AT 15°.

	Final volume of the liquid.		Volume of baryta- water saturating 10 c.c. of the liquid.		Co-efficient of division.
	Aqueous. Ethereal.		Aqueous. Ethereal.		
	c.c.	c.c.			
Concentrated liquids.	70	30.0	42.4*	7.1	6.0
	49	49.0	43.8	7.4	6.0
	28	55.5	47.4	7.9	6.0
More diluted liquids.	30	70.0	18.8	3.4	5.5
	17	17.0	16.2†	3.0	5.4

The co-efficient of division of a body between two solvents is analogous to the co-efficient of division of a gas between a liquid, which will dissolve it, and an empty superposing space; but, in the latter case, it is the tension of gas in the unit of volume of the empty space, which determines the quantity dissolved in the entire volume of liquid. In the case of a body divided between two solvents, it is the final quantity dissolved in the unit of volume of one of these liquids, which determines the quantity dissolved in the unit of the other.

*Influence of Temperature.*—The co-efficient of division changes with the temperature, but very slowly.

				Weight of succinic acid contained in 10 c.c. of the liquid.		Co-efficient of division.	
At 15° ..	..	..	0.376	0.060	..	..	6.2
„ 0° ..	..	..	0.376	0.078	..	..	4.9
„ 15° ..	..	..	0.106	0.019	..	..	5.5
„ 0° ..	..	..	0.098	0.019	..	..	5.0

*Influence of Concentration.*—The co-efficient of division varies with the final concentration of the solvents, but not in proportion to the weight dissolved; its progress is slower.

Experiments with malic, tartaric, and acetic acids demonstrate that the co-efficient varies more rapidly with the concentration when very soluble bodies are under treatment, than with those which are less so. This difference is explicable because concentrated solutions of tartaric or acetic acid dissolve ether in proportions differing from those effected by diluted solutions.

Sulphuric and chlorhydric acids give rise to a remarkable analogy; ether will dissolve them only when they are

\* Equivalent to 0.358 gr. of succinic acid.

† Equivalent to 0.122 gr. of succinic acid.



concentrated. The proportion of acid obtained from their aqueous solutions, which are slightly diluted, is almost inappreciable.—*Comptes Rendus*.

### ANALYSIS OF METEORITES.\*

By A. R. LEEDS.

DOUBTS having been expressed as to the meteoric origin of a mass of iron, weighing about 300 lbs., which was found upon the Collina di Brianza in Lombardy, an analysis has been made by Dr. Haushofer.† The doubt probably arose from a remark made in the original description, by Chladni, to the effect that Stromeyer had found CO<sub>2</sub> in the mineral. Dr. Haushofer shows that the milkiness which is given when a portion of the mineral, in the form of filings, is burnt in oxygen, and the gas passed through lime-water, is so excessively small that the amount of carbonic anhydride contained in the mineral must be disregarded. The analysis gives:—Fe, 91.1; Ni, 7.7; P, 0.3; Co, 0.2; CO<sub>2</sub>, trace. The sp. gr. is 7.596. The Widmannstädtchen figures are brought out strongly on etching the cut faces.

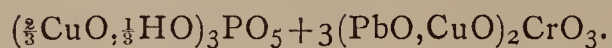
An analysis of the oxidised remains of a meteorite from Cranbourne, in Australia, by the same chemist, gives:—Insoluble silicates, 4.1; SiO<sub>2</sub>, 2.3; Al<sub>2</sub>O<sub>3</sub>, 1.5; Ca, 1.8; PO<sub>5</sub>, 1.4; Fe<sub>2</sub>O<sub>3</sub>, 71.1; NiO, 3.1; H<sub>2</sub>O, 13.7=99.0.

The external appearance of the analysed portions is very similar to that of brown clay ironstone or bog-ore: its meteoric origin is shown, however, by the presence of nickel. The hardness is about that of feldspar; sp. gr., 3.74.

An examination of the minerals resembling vanquelinite, in the Royal Museum at Stockholm, has revealed to A. E. Nordenskjöld the existence of a new mineral, a double salt of chromic and phosphoric acids, for which he proposes the name Laxmannite.‡ Two analyses give:—

	I.	II.
Plumbic oxide.. ..	61.26	61.06
Cupric „ .. ..	12.43	10.85
Ferric „ .. ..	1.09	1.28
Chromic acid .. ..	15.26	16.76
Phosphoric acid .. ..	8.05	8.57
Water .. ..	1.31	0.90
	99.40	98.42

and agree with formula—



The laxmannite forms crystalline crusts some lines in thickness, or crystalline masses filled with drusy cavities, whose walls are covered with dark green, glistening crystals. The cleavage is partly crystalline, partly massive and earthy; the colour dark green to pistachio and greyish green. The crystals are monoclinic prisms.—*Journal of the Franklin Institute*.

### METALLIC HYDROGEN.

At a recent meeting of the Lyceum of Natural History, in New York, a paper was read by Dr. Loew, Assistant in the College of New York, "On the Preparation of Hydrogen Amalgam."

The researches of Graham went to show that hydrogen could be alloyed with palladium, and that it was also contained in meteoric iron. He condensed the hydrogen in the palladium, and came nearer proving its metallic

character than any other person had done. Schoenbein in his search for ozone, found a method for making the peroxide of hydrogen, which brought him to the very threshold of discovering hydrogenium. Schoenbein's experiment was this—An amalgam of zinc and mercury is violently agitated in water; the water is then filtered, and, on being examined with iodide of starch and protosulphate of iron, will be found to contain peroxide of hydrogen or oxygenated water. Dr. Loew has carried the investigation further, and has, instead of oxidising the hydrogen, succeeded in combining it with the mercury. He takes an amalgam composed of not more than 3 or 4 per cent of zinc, and shakes it with a solution of bichloride of platinum; the liquid becomes black, and a dark powder settles to the bottom. The contents of the flask are then thrown into water, and hydrochloric acid added to dissolve the excess of zinc. The amalgam of hydrogen and mercury at once forms in a brilliant voluminous mass, resembling in every way the well-known ammonium amalgam. It is soft and spongy, and rapidly decomposes, but without any smell of ammonia. The hydrogen escapes, and soon nothing but pure mercury is left in the dish. The experiment appears to show conclusively that an amalgam of hydrogen and mercury can be formed, and that hydrogen is really a metal. It would also throw some doubt upon the existence of the amalgam of ammonium and mercury, and offer an explanation of that compound on the basis of its being the same amalgam of hydrogen and mercury that is prepared in the way now pointed out by Dr. Loew. The smell of escaping ammonia must be traced to some other source than the existence of that radical in combination with mercury.—*Abstract from the Scientific American*.

### NICKEL LINNÆITE.\*

By A. R. ROESSLER,  
Geologist, General Land Office, Washington.

THE valuable metal, nickel, now employed extensively in preparing various alloys resembling silver, for table use, and in making the coins of the United States and other countries, has been but seldom found in this country. In small but not paying quantities, there are several localities of it; and the only one which promises to yield it in abundance is the deposit at Mine la Motte, Missouri, so celebrated already for its copper, lead, iron, and other ores. A specimen of nickel-linnæite or siegenite has been received at the Geological and Mineralogical Cabinet of the General Land Office, yielding over 30 per cent of nickel. Nickel was discovered in 1751, by Cronstedt, in Sweden. It is a metal of a colour not much differing from that of silver; it is magnetic, soft, and malleable; may be forged, rolled, bored, drawn into wire, &c.; it is more tenacious than iron, and less subject to oxidation than silver. In the year 1824 (the statement may yet be found in Thenard's *Traite de Chemie*), it was stated that the metal, nickel, could not be put to any use. However, it was long before this that nickel was employed by the Chinese for the preparation of an alloy termed by them "Packfong;" and, although, in 1776, Englestroem had analysed this composition, no practical application of this metal was made for some time.

The separation of nickel from its ores is exceedingly difficult and complicated. The crude material is the cobalt speiss and the matt obtained in lead and copper smelting works. In order to free this material from arsenic and sulphur, it is first finely pulverised and roasted with pulverised coal. The residue is dissolved in muriatic acid, and the solution diluted with much water in order to separate the bismuth. If the liquid is now mixed with hypochlorite of lime, the iron is oxidised to a peroxide,

\* Communicated by Professor Morton.

† *Journ. für Prakt. Chem.*, 1869, p. 328.

‡ *Ann. de Phys. und Chem.*, 136, 299.

\* Communicated by Professor Morton.



when it may be precipitated with the arsenic acid existing in the liquid. If the liquid is to be freed from copper, a current of hydrogen is conveyed through the same, and, having separated the precipitate produced, the cobalt is thrown down by hypochlorite of lime. Now the nickel may be separated with milk of lime. In subjecting the precipitate, with carbon, to a red heat, the metal may be obtained in its pure state. The manufacture of "Pack-fong" in Europe is not of a very old date. This term is synonymous with argentum, German-silver, British-plate, Its composition varies considerably, as may be seen from the following table:—

	I.	II.	III.	IV.	V.	VI.
Copper..	88.00 ..	65.0 ..	43.8 ..	40.4 ..	55.0 ..	50.0
Nickel ..	8.75 ..	16.8 ..	15.6 ..	31.6 ..	20.0 ..	25.0
Zinc ..	— ..	13.0 ..	40.6 ..	25.4 ..	25.0 ..	25.0
Iron ..	1.75 ..	3.4 ..	— ..	2.6 ..	— ..	—
	98.50	98.2	100.0	100.0	100.0	100.0

It may be seen from this that an alloy may be made with less than 10 per cent of nickel; but the wearing-quality of the metal is decidedly injured by too great a reduction in the quality of nickel.

I will remark that No. 1 is the so-called "white copper," made in Suhl, Germany, a century ago, with copper ores containing nickel, and analysed by Brandes. No. 2 is an alloy, made at Paris, which is capable of receiving a fine polish or gilding. Nos. 3 and 4 are Chinese packfong. No. 5 is an alloy as used for knife-handles. No. 6 is adapted for forks. The nickel coins of Switzerland, which have been in use in that country since 1850, consist of an alloy of nickel, copper, zinc, and silver. The proportion of nickel and zinc in the 20, 10, and 5 centimes-pieces is 1.25. While the amount of copper increases with the decreasing value of the coin, the quantity of silver, on the other hand, decreases with the smaller value. The United States' coins now in general circulation contain 88 per cent of copper and 12 per cent of nickel.—*Journal of the Franklin Institute.*

## CONTRIBUTIONS TO THE CHEMISTRY OF COPPER.\*

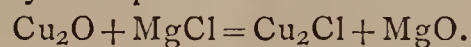
By T. STERRY HUNT, LL.D., F.R.S.

1. THE resemblances between silver and copper, in its cupreous form, have already attracted the attention of chemists. The ordinary chloride of silver (argentic chloride) and the dichloride of copper (cupreous chloride) have many properties in common. Both of these chlorides are white, readily fusible, and blackened by exposure to light. Both of them are insoluble in water, but dissolve in ammonia and in aqueous solutions of other chlorides, in which, however, the cupreous is far more soluble than the argentic chloride. A saturated solution of chloride of sodium holds, at 90° C., 16.9 per cent of cupreous chloride; at 40° C., 11.7 per cent; and, at 11° C., 8.9 per cent. A solution containing 15 per cent of chloride of sodium retains, at 90° C., 10.3 per cent of cupreous chloride; at 40°, 6.0 per cent; and, at 14°, 3.6 per cent; while a solution with only 5 per cent of chloride of sodium holds, of the cupreous chloride, at 90°, 2.6, and, at 40°, only 1.1 per cent. These determinations are from single observations, and, therefore, require verification. From the sparing solubility of the cupreous chloride in dilute solutions of chloride of sodium, it follows that the denser saturated solutions are copiously precipitated by dilution with water, which causes the separation of white cupreous chloride in a crystalline condition.

\* Read before the American Association for the Advancement of Science, at Salem.

2. The aqueous solutions of the chlorides of calcium, magnesium, zinc, manganese, cobalt, ferrosium, and cuprosium also freely dissolve cupreous chloride; and it is probable that this property is shared by other soluble chlorides. The strong affinity of cuprosium for chlorine enables cupreous oxide to decompose all the chlorides just named, with the exception of those of sodium and calcium, with separation of the corresponding oxides and formation of cupreous chloride. In the case of zinc and manganese, insoluble oxychlorides of these metals are formed at the same time. These reactions require further study; and the same may be said of the cupric and cobaltic chlorides with cupreous oxide. I have, however, partially investigated the behaviour of cupreous oxide with magnesian and ferrous chlorides, and obtained the results about to be described.

3. The cupreous oxide, for these experiments, was prepared by gently heating a solution of sulphate of copper, mixed with cane-sugar and an excess of caustic soda, until the whole of the copper was thrown down as a bright, dense cinnabar-red powder, which was carefully washed and dried. A concentrated solution of chloride of magnesium dissolves this oxide in the cold, and more readily when heated, with separation of hydrated oxide of magnesium and cupreous chloride, which latter is held in solution by the excess of magnesian chloride. By filtering the liquid while hot, and washing with a strong solution of chloride of sodium, the hydrate of magnesia may be separated, and the dissolved copper subsequently precipitated by metallic iron from the colourless filtrate, ferrous chloride being formed. Experiment shows that the reaction between the red oxide of copper and chloride of magnesium may be represented as follows:—

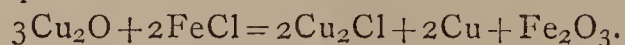


4. A solution of magnesian chloride, nearly saturated, when hot, with cupreous oxide, and allowed to cool in contact with the precipitated magnesian hydrate, deposits a portion of orange-coloured oxide, or perhaps an oxychloride, which disappears as often as the solution is heated. The solid cupreous chloride is, moreover, decomposed when digested with water and magnesia, hydrated cupreous oxide and magnesian chloride being formed. The double chloride of cuprosium and magnesium is, however, stable, even in the cold, in presence of magnesian hydrate, provided a considerable excess of magnesian chloride be present. From a filtered solution of cupreous oxide in chloride of magnesium, water precipitates a large portion of the cupreous chloride, in this case, coloured orange-yellow from adhering oxide, due to the reaction of a little magnesia which remains dissolved or suspended in the concentrated solution, even after filtration. A solution of magnesian chloride of sp. gr. 1.23 retains in solution, at 12° C., about 7.10 per cent of cupreous chloride. A solution of magnesian sulphate, with chloride of sodium, may be employed to dissolve cupreous oxide. This, like all similar solutions of cupreous chloride, rapidly absorbs oxygen from the air, and deposits a pale-green cupric oxychloride.

5. With ferrous chloride and cupreous oxide, it might be expected, from analogy with the magnesian salt, that we should obtain cupreous chloride and ferrous oxide; but the reaction is complicated by the tendency of the latter to pass to the state of ferric oxide. When ferrous chloride in solution with chloride of sodium is heated with a sufficient quantity of cupreous oxide, the whole of the iron is precipitated as ferric oxide, mingled with metallic copper, while cupreous chloride remains in solution. Experiments made with an excess of ferrous chloride show that one-third of the copper is reduced, while two-thirds are dissolved as dichloride. This reduction may be effected directly by ferrous oxide. If, to a solution of cupreous chloride in chloride of sodium, we add hydrated ferrous oxide recently precipitated by an alkaline base and still suspended in the liquid, it is at once converted into ferric oxide, with precipitation of metallic copper. The first stage in the action of ferrous chloride on cupreous

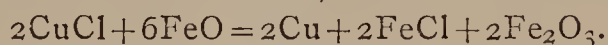


oxide may be represented as similar to that of magnesian chloride,  $\text{Cu}_2\text{O} + \text{FeCl} = \text{Cu}_2\text{Cl} + \text{FeO}$ ; in the second stage,  $\text{Cu}_2\text{Cl} + 3\text{FeO} = \text{Cu}_2 + \text{FeCl} + \text{Fe}_2\text{O}_3$ . It follows from this that one-third of the cupreous chloride formed in the first stage is reduced to the metallic state; and the final result may be represented as follows:—



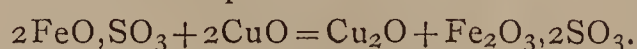
A similar result is obtained if ferrous chloride is added to an unfiltered solution of cupreous oxide in chloride of magnesium. The suspended hydrate of magnesia, in this case, liberates an equivalent of ferrous oxide, which reduces to the metallic state one-third of the dissolved cupreous chloride, in accordance with the second reaction given above.

6. The reducing power of ferrous oxide is also shown with cupric chloride, which is at once converted by it into cupreous chloride, in accordance with the equation  $2\text{CuCl} + 3\text{FeO} = \text{Cu}_2\text{Cl} + \text{FeCl} + \text{Fe}_2\text{O}_3$ . The further action of ferrous oxide will, as we have seen, reduce the cupreous chloride to the metallic state; in fact—



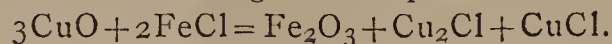
If recently-precipitated hydrated ferrous oxide or ferrous carbonate be added to a solution of cupric chloride in the proportions indicated by the last equation, the whole of the copper is separated in the metallic state, mingled with ferric oxide; while ferrous chloride is found in solution. The reaction with ferrous carbonate, which requires a gentle heat, is accompanied by a violent disengagement of carbonic-acid gas. This experiment is best made by dissolving in water ferrous sulphate and sodic carbonate, or sodic hydrate, in the proportions required, and adding thereto a solution holding the proper amount of cupric chloride. Under certain conditions, the cupreous precipitate is brownish black in colour, like that obtained by heating ferrous chloride with cupreous oxide; but more generally it is of a bright red colour, and often coats the glass with a mirror-like film. A warm solution of cupric chloride with chloride of sodium at once converts the metallic copper of the precipitate into cupreous chloride, which is dissolved, leaving behind only hydrated ferric oxide. When a solution of ferrous chloride with chloride of ammonium and excess of ammonia is added to a solution of a copper-salt, the precipitated films of metallic copper sometimes possess considerable brilliancy, and show a bluish translucency. It is to be remarked that, although the cupreous precipitate thus obtained is bright red in colour, that which is produced by boiling cupreous oxide with ferrous chloride is nearly black.

7. It was long since shown by Levol that hydrated ferric oxide will reduce cupric to cupreous oxide; and this, as we have already seen, can separate from its combinations ferrous oxide, whose reducing power may be still further exerted upon the cupreous combination thus formed. These facts serve to explain the results obtained by E. Braun (*Zeitschr. Chem.*, 1867, p. 568; cited in *Jahresberichte* for 1867), which were not known to me at the time of making these experiments. He found that, by digesting cupric hydrate or cupric carbonate with ferrous sulphate in solution, there was obtained a reddish mixture of basic ferric sulphate with cupreous oxide, formed, apparently, in accordance with the equation—



This, when boiled with a further portion of ferrous sulphate, became black in colour, and, from the small amount of oxygen present, was supposed to contain metallic copper. By adding a large excess of carbonate of ammonia to a mixture of ferrous and cupric sulphates, Braun succeeded in obtaining solutions in which all the copper was present in a cupreous form, and even in reducing portions of it to the metallic state—a process which we have seen is complete when the requisite amount of ferrous oxide is brought in contact with the chlorides of copper.

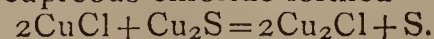
8. In *Silliman's Journal* for March, 1867, p. 308, I described briefly the reaction between cupric oxide and ferrous chloride according to the equation—



I was not then aware that the same had been shown by Meyer (*Berg. und Hutt. Zeit.*, 1862, p. 182; cited by Kerl).<sup>\*</sup> Further studies of this reaction have given me interesting results. The black oxide of copper, even after ignition, is attacked by ferrous chloride in the cold; but the insolubility of the resulting cupreous chloride retards the action. If, however, the ferrous chloride be mingled with a strong solution of chloride of sodium, and heat applied, the cupreous chloride is readily dissolved, and the reaction is rapid and complete, the whole of the iron separating as a bulky, reddish brown precipitate, provided 3 equivalents of cupric oxide have been taken for 2 of ferrous chloride. The greenish solution thus obtained readily dissolves precipitated metallic copper, in virtue of the cupric chloride which it contains, and, unless a large excess of chloride of sodium be present, deposits white crystalline cupreous chloride by cooling or by dilution. When digested, at a temperature of 50° C., with carbonate of lime, the greenish solution deposits one-third of its copper as a pale green, insoluble, cupric hydrocarbonate, while the colourless filtrate retains the remaining two-thirds in the form of cupreous chloride. If a solution of ferrous chloride with chloride of sodium is digested with a sufficient excess of cupric oxide, the cupric chloride formed unites with the latter to form an insoluble cupric oxychloride, and only cupreous chloride remains in solution.

9. For the ferrous chloride in the experiments in Nos. 5 and 8, a solution of ferrous sulphate with chloride of sodium may be substituted. When cupric oxide is heated with an excess of ferrous chloride, a small portion of ferric oxychloride is produced. The red-brown precipitate may be washed free from cupric, cupreous, and ferrous chlorides by a strong solution of chloride of sodium, but will then yield to pure water a portion of soluble ferric oxychloride. By careful desiccation in a water-bath, and subsequent washing with dilute alcohol, the ferric precipitate may be obtained free from chloride of sodium, and completely insoluble in water; but its composition appears to be variable. Of two preparations, the first contained 1 equivalent of chlorine for 11, and the second 1 for 20 equivalents of iron. In another experiment, where fine oxide of copper from the calcination of malachite was dissolved in an excess of a mixture of ferrous sulphate and chloride of sodium at a boiling heat, it was found that, for 30 equivalents of copper dissolved, there were precipitated 21 equivalents of iron, instead of 20, as required by the formula given in No. 8; the additional equivalent being separated as ferric chloride in union with the ferric oxide. The production of a small and variable amount of ferric chloride in the above conditions is apparently due to a secondary reaction between cupric and ferrous chlorides in the presence of ferric oxide,  $2\text{CuCl} + 2\text{FeCl} = \text{Cu}_2\text{Cl} + \text{Fe}_2\text{Cl}_3$ . This point, however, requires further investigation.

10. The facility with which cupric chloride parts with one-half of its chlorine, and passes into the more stable cupreous compound, is shown by its well-known power to chloridise, not only metallic copper, but metallic silver, and even sulphide of silver. Its action on cupreous sulphide is not less remarkable. A strong solution of cupric chloride, mingled with chloride of sodium, rapidly attacks pulverised copper-glance, even in the cold, sulphur being separated and cupreous chloride formed—



Chalcopyrite, on the contrary, is but slightly acted upon by such a solution, which, however, slowly takes up a portion of iron, forming ferrous chloride with a corresponding amount of cupreous chloride.—*American Journal of Science*.

<sup>\*</sup> "Metall. Huttenkunde," vol. xi., p. 588.



ON THE  
ABSORPTIVE POWER OF SOIL.\*

By ROBERT WARINGTON, F.C.S.

(Continued from p. 210.)

WE now pass to the experiments made in the college laboratory,† after an account of which we will attempt a review of the whole subject.

The investigation we are about to describe was confined to the single inquiry, What is the part taken by oxide of iron and alumina in the absorptive action of soils? In *Practice with Science*, vol. i., p. 333, an account has been already given of the earliest of these experiments. It was then stated that both hydrated oxide of iron and alumina possessed in a remarkable degree the power of removing phosphoric acid from the solution of a phosphate. The experiment was made with a solution of phosphate of calcium in carbonic acid water, and it was found that by contact with a relatively small bulk of either of these hydrates, 96 to 97 per cent of the phosphoric acid originally present was withdrawn, while the calcium was left dissolved in the liquid in the form of carbonate. The chemical decomposition of the phosphate of calcium was thus all but complete; a basic phosphate of either iron or aluminium was produced, and the calcium, at the end of the reaction, was united to carbonic in place of phosphoric acid. These results suggested the question, Whether the property of soils of withdrawing phosphoric acid from the solutions of its salts was not owing to the presence in soils of oxide of iron and alumina? whether, in fact, the absorption of phosphoric acid was not a simple consequence of the chemical affinity existing between it and these hydrated oxides? The next experiments were made with the object of testing the correctness of this conclusion. Did soil comport itself towards a solution of a phosphate in a manner similar to that shown by oxide of iron under the same circumstances?

In the experiments with soil, the same method was followed as in the experiments with the pure hydrated oxides. The soil was placed in contact with a solution of phosphate of calcium in carbonic acid water, the liquid being kept saturated with the gas, and, after some days, the amount of calcium and phosphoric acid removed from the solution was ascertained. If no chemical action had been exerted by the soil, the phosphate of calcium would be either undiminished or else absorbed without decomposition, in which case equal proportions of calcium and phosphoric acid would be removed from the solution. If, however, the soil acted in a manner similar to the oxide of iron, the phosphate of calcium would be more or less decomposed, its acid withdrawn, while the calcium remained dissolved. A little reflection, however, showed that perfectly sharp results could not be expected in experiments with soils, from their well-known behaviour towards solutions of carbonic acid and solutions of calcium salts. A soil containing lime will give up a portion of it if treated with a solution of carbonic acid. If such a soil were used for the experiment, calcium might be expected to pass from the soil into the solution; and if, at the same time, a portion of the phosphate were absorbed, it would appear as if the phosphate had been decomposed without this having perhaps occurred, since an excess of calcium would be shown by analysis to exist in the remaining solution. On the other hand, most soils absorb carbonate of calcium from its solution in carbonic water; and operating with such a soil, the carbonate of calcium, resulting from the decomposition of the phosphate, would itself be absorbed by the soil, and thus the evidence of the decomposition be lost.‡ It was

thought safer to avoid the former error, and to choose soils for the trial which did not yield calcium to carbonic acid water, since, in this case, though the decomposition of the phosphate might appear but small, from the subsequent absorption of the carbonate of calcium, there could be no question as to its reality if found to occur to any appreciable extent.

The two soils employed had the following composition:—

	Soil A.	Soil B.
Moisture .. .. .	1.54	6.57
Organic and volatile matter ..	3.69	17.03
Silica and insoluble silicates ..	87.31	55.29
Oxide of iron and alumina ..	6.82	19.31
Phosphoric acid .. .. .	0.05	0.34
Lime .. .. .	0.11	0.28
Magnesia .. .. .	0.14	0.63
Potash .. .. .	0.16	
Carbonic acid, traces of other substances, and loss .. ..	0.18	0.55
	100.00	100.00

Notwithstanding the very small amount of lime in these soils, they were found to give up some of it when digested with carbonic acid water. The portion of soil taken for experiment was, therefore, repeatedly digested with carbonic water, and as this removed the lime but slowly, the soils were, in the earlier experiments, further treated with weak acetic acid, and then thoroughly washed with water: all soluble calcium salts were thus removed.

In the first two experiments, 600 grms. of soil were treated with 8000 grms. of a solution of tricalcic phosphate in carbonic water, and carbonic acid gas was passed through the mixture from time to time. At the end of eighteen days the solution was removed from the soil and analysed. Analysis showed that soil A had absorbed 50.8 per cent of the phosphoric acid originally present, and 43.2 per cent of the lime; while soil B had absorbed 96.1 per cent of the phosphoric acid, and 61.5 per cent of the lime.

The experiment with soil B was once more repeated: the soil was this time not treated with acetic acid, but washed with carbonic water only. 400 grs. of the soil were treated as above with 800 grs. of a solution of tricalcic phosphate. After six days the liquid was removed and analysed. The soil had, in this instance, absorbed 93.8 per cent of the phosphoric acid, and 49.0 per cent of the lime.

In all these experiments there was evidently a decomposition of the phosphate of calcium by the soil, this being most marked in the case of soil B; in each experiment there was, however, a very considerable absorption of lime as well as of phosphoric acid. It was, in fact, proved in every case that a part of the phosphoric acid absorbed had been withdrawn by chemical action, but in no case did the proof extend to the whole of the phosphoric acid removed by the soil. We have already noticed that the property possessed by soil of absorbing carbonate of calcium from its solution in carbonic acid, necessarily deprived us of the evidence requisite to complete the proof.

That there might be no doubt that the soils experimented with had the faculty of removing carbonate of calcium from a carbonic solution, a trial was made with soil B—the soil which had given the greatest absorption both of lime and phosphoric acid. 400 grs. of this soil were placed in contact with a weak solution of carbonate of calcium in carbonic acid water, the experiment being conducted as before. At the end of six days the soil had withdrawn 27.4 per cent of the carbonate of calcium present.

The experiments with soil might, doubtless, have been extended with advantage; the evidence was, however, sufficient to convince me that the natural hydrated oxide of iron contained in soil behaved in the same manner

\* *Practice with Science*, vol. ii.

† These experiments were made by the writer in 1865–7, while assistant teacher of chemistry at the college.

‡ Theoretically there would be for every soil a certain strength of solution of carbonate of calcium in carbonic water, in which the soil would neither give up nor absorb lime.



towards phosphoric acid as the artificially prepared hydrate had been found to do in the earlier experiments.

The concluding investigation was upon the absorptive power of the hydrated oxides for salts of potassium and ammonium. Hydrated oxide of iron and hydrated alumina were prepared by precipitation; they were very

thoroughly washed by decantation before use. Known quantities of these hydrates and of the various salt solutions were then mixed, and after contact for a day or two the amount of absorption was ascertained by an analysis of the liquid. The following tables show the amount of absorption ascertained for each salt; the figures given are in most cases the mean of several experiments:\*

#### ABSORPTION OF SALTS OF POTASSIUM BY HYDRATED FERRIC OXIDE AND HYDRATED ALUMINA.

Salt employed.	Strength of solution.		Amount absorbed by 100 of hydrated ferric oxide (Fe <sub>2</sub> H <sub>6</sub> O <sub>9</sub> )†		Amount absorbed by 100 of hydrated alumina (Al <sub>2</sub> H <sub>6</sub> O <sub>6</sub> )†	
	Per cent of salt.	Per cent of potash.	Calculated as salt.	Calculated as potash.	Calculated as salt.	Calculated as potash.
Carbonate of potassium .. .. .	0.995	0.678	7.17	4.89	1.49	1.02
Sulphate of potassium .. .. .	1.077	0.582	1.94	1.05	0.55	0.30
Chloride of potassium .. .. .	1.053	0.664	0.36	0.23	No trial.	—
Nitrate of potassium .. .. .	1.049	0.488	0.38	0.18	0.27	0.12

#### ABSORPTION OF SALTS OF AMMONIUM BY HYDRATED FERRIC OXIDE AND HYDRATED ALUMINA.

Salt employed.	Strength of solution.		Amount absorbed by 100 of hydrated ferric oxide. (Fe <sub>2</sub> H <sub>6</sub> O <sub>9</sub> )†		Amount absorbed by 100 of hydrated alumina. (Al <sub>2</sub> H <sub>6</sub> O <sub>6</sub> )†	
	Per cent of salt.	Per cent of ammonia.	Calculated as salt.	Calculated as ammonia.	Calculated as salt.	Calculated as ammonia.
Carbonate of ammonium .. .. .	0.930	0.329	5.40	1.91	2.04	0.72
Sulphate of ammonium .. .. .	1.382	0.356	2.17	0.56	0.74	0.19
Chloride of ammonium .. .. .	0.958	0.304	0.20	0.07	No trial.	—
Nitrate of ammonium .. .. .	1.552	0.330	0.35	0.08	No trial.	—

Two points strike us at once on inspecting these tables.

In the first place, the absorbent action of alumina is clearly much less than that of ferric oxide. With carbonate and sulphate of potassium the oxide of iron takes up about four times as much as the alumina; with the corresponding ammonium salts it takes up about three times as much as the alumina.

In the next place, it is very evident that both with oxide of iron and alumina the amount of absorption varies greatly with different salts of the same base.† The carbonates of potassium and ammonium are seen to have been absorbed to a considerable extent, the sulphates to a small extent, while of the chlorides and nitrates only traces were taken up. This order of absorption, it will be remarked, is the same as that generally observed in absorption by soil. With soil, however, the absorption from the sulphate, chloride, and nitrate, is proportionately far greater than in the present case. The difference is, doubtless, owing to the important assistance given by the lime of soil, which, combining with the acids of these salts, allows the bases to be absorbed as hydrates. It was attempted in a few experiments to imitate the conditions of soil by adding carbonate of calcium to the hydrated oxides. Some further absorption was obtained in a few cases by this means, but the imitation of the conditions of soil was clearly very imperfect.

It was a point of great importance to decide if the absorption in these experiments was due to a chemical or a physical action. With this view attention was paid to any evidence of a decomposition of the salt during the reaction.

In the case of carbonate of potassium, it was found that the carbonic acid was not absorbed to the same extent as the potassium, but that an excess of acid remained in

every instance in the final solution. In three experiments with hydrated ferric oxide there were absorbed for ten equivalents of potassium, 3.6, 4.5, and 7.9 equivalents of carbonic acid. The proportion of carbonic acid absorbed was thus very various. The variation was evidently connected with the amount of potassium removed from solution, as the following figures will show:—

	Potassium absorbed for 100 originally present.	Equivalents of Carbonic Acid absorbed for 10 of Potassium.
Experiment 1 .. .. .	6.84	3.6
Experiment 2 .. .. .	18.67	4.5
Experiment 3 .. .. .	32.57	7.9

Thus, the weaker the solution became during the absorption, the greater was the proportion of carbonic acid taken up. It seems that ferric oxide commences by absorbing potash almost to the exclusion of carbonic acid; by so doing, the proportion of carbonic acid in the liquid must be increased. But this accumulation of acid in the liquid appears to act as a check on the further decomposition of the potassium salt, which, therefore, takes place to a less and less extent as the absorption progresses. In one experiment with hydrated alumina, the decomposition of the carbonate of potassium was complete, potash was taken up, but no carbonic acid.

In the experiments with carbonate of ammonium, the absorption of carbonic acid was determined in one instance only. The ferric oxide in this case absorbed carbonic acid and ammonia in the proportions to form neutral carbonate; the salt used had contained, as is usual with the commercial article, an excess of carbonic acid—a slight decomposition had therefore probably taken place.

In the experiments with sulphates, it was noticed that the solution of sulphate of ammonium became distinctly alkaline on contact with either ferric oxide or alumina; with the latter the reaction was very marked. A determination of the amount of sulphuric acid and ammonia removed by the alumina showed that, for 10 equivalents of ammonia, 28.2 equivalents of sulphuric acid\* had been

\* By an equivalent of sulphuric acid, is here understood the amount required to form sulphate of ammonium with 1 equivalent of ammonia.

\* For the analytical details the reader is referred to the *Journal of the Chemical Society*, vol. vi., p. 1.

† These formulæ represent the composition of the hydrates actually employed.

‡ The reader will observe, by reference to the table, that the strength of the salt solutions employed was not in every case regulated by the chemical equivalent of the salt. In this, and several other particulars, the experiments admit of considerable improvement. These errors, pointed out by experience subsequently gained, do not, however, affect any of the conclusions here drawn.



taken up. The acid had here been absorbed in far greater proportion than the base. Solution of sulphate of potassium became slightly alkaline on contact with alumina; with oxide of iron, no change was observed.

Solutions of chloride and nitrate of ammonium became alkaline on contact with ferric oxide, showing that the acid was taken up to a greater extent than the base; the parallel experiments with alumina were here wanting. The corresponding potassium salts were unaffected by contact with ferric oxide.

We have here very distinct evidence that the absorption by ferric oxide and alumina was attended with a chemical decomposition of the salt absorbed; this decomposition was, however, rarely complete, both acid and base being in most cases taken up, though in unequal proportions. To a chemist, alumina and ferric oxide are known to behave as feeble bases towards strong acids, and as feeble acids towards strong bases; we can, therefore, from a chemical point of view, readily understand the preponderating absorption of base from the salt of a weak acid, as a carbonate, and the preponderating absorption of the stronger acids from their comparatively feeble combinations with ammonium. Again, the well-known readiness with which ferric oxide and alumina form highly basic compounds, and also salts (as alum) containing two bases to one acid, seems to render a purely chemical explanation of the whole of these reactions quite easy. It is not, however, denied that hydrated ferric oxide and alumina are capable of taking up certain substances by virtue of physical attraction, but it is believed that such an action has had no place in the absorption of the salts here described.

A single experiment was made as to the retention of potash by ferric oxide when the latter was washed with water. Hydrated ferric oxide which had absorbed potash from the carbonate was submitted to two washings with thorough agitation, each washing remaining in contact one day. The ferric oxide was then found to have lost two-thirds of its potassium. The washing was sufficient to have reduced a perfectly soluble salt to  $\frac{1}{14}$ th its original quantity. The compound with iron was thus decomposed by water, but with some difficulty.

(To be continued.)

## PROCEEDINGS OF SOCIETIES.

### CHEMICAL SOCIETY.

May 5th, 1870.

Professor WILLIAMSON, F.R.S., President, in the Chair.

THE following gentlemen were elected Fellows:—G. Matthey, T. Steel, T. Allen.

Mr. BROWN read a paper "On Vapour Densities," wherein he gave a historical review of the various methods employed for the determination of vapour densities.

Mr. CHURCH communicated "The Analyses of Two Cornish Minerals."

The one, restormelite, was obtained from the Restormel Iron Mines, and may be regarded as a variety of kaolinite, standing nearest to the lithomarge group. Its specific gravity and its hardness are nearly the same as those of lithomarge. In its percentage of silica and alumina (its chief constituents) it does not differ from that of lithomarge; but, while restormelite contains 7 per cent of soda and potash, lithomarge contains a mere trace of these alkalis. Mr. Church considers restormelite as preserving in its alkalis more evident traces of its feldspathic origin than we usually find in such alteration-products. The following percentages were obtained in six analyses:—

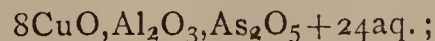
	I.	II.	III.	IV.	V.	VI.
H <sub>2</sub> O ..	11.69 ..	— ..	11.75 ..	11.64 ..	11.65 ..	— ..
SiO <sub>2</sub> ..	— ..	— ..	44.77 ..	45.66 ..	— ..	— ..
Fe <sub>2</sub> O <sub>3</sub> ..	— ..	— ..	1.11 ..	1.25 ..	— ..	0.98 ..
Al <sub>2</sub> O <sub>3</sub> ..	— ..	— ..	35.05 ..	35.66 ..	— ..	34.58 ..
MgO ..	— ..	0.92 ..	0.69 ..	0.95 ..	— ..	— ..
K <sub>2</sub> O ..	— ..	2.10 ..	2.51 ..	— ..	— ..	— ..
Na <sub>2</sub> O ..	— ..	4.12 ..	4.12 ..	— ..	— ..	— ..

These results correspond pretty well with the formula of kaolinite, Al<sub>2</sub>O<sub>3</sub>2SiO<sub>2</sub>+2aq, if we suppose several replacements, such as a partial replacement of hydrogen by sodium or potassium, and of aluminium by iron.

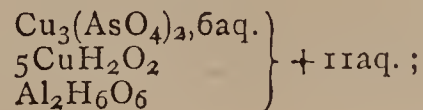
The other of the above-mentioned minerals is chalcophyllite. The recorded analyses of this mineral are by no means satisfactory. Chevenix found in it 58 per cent of cupric oxide, and 21 of water; Hermann, 44.45 per cent of CuO, and 31.19 of water; and Damour, 52.61 of CuO, and 23.26 of water. Of course, it was rather difficult to assign a formula for so variable a substance. Mr. Church has devoted much time and labour to an endeavour to clear up the mystery of its constitution; and he obtained the following percentage as the mean of several analyses:—

H <sub>2</sub> O (lost at 100°)	..	..	..	14.06
CuO	..	..	..	46.14
Al <sub>2</sub> O <sub>3</sub>	..	..	..	5.97
Fe <sub>2</sub> O <sub>3</sub>	..	..	..	0.60
As <sub>2</sub> O <sub>5</sub>	..	..	..	15.54
H <sub>2</sub> O (by difference)	..	..	..	31.75

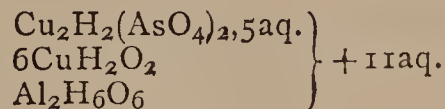
These results lead to the formula—



or as well to  $8\text{CuO}, \text{Al}_2\text{O}_3, \text{As}_2\text{O}_3 + 25\text{aq.}$ ; and these elements of chalcophyllite may be viewed as arranged in the following manner:—



Or—



It ought to be stated that chalcophyllite cannot be dried, even *in vacuo*, without an entire change in its appearance; the transparent beautiful green crystals become opaque and of a more bluish green. These changes correspond to a loss of 13.79 per cent of water. At 100°, the insignificant further loss of 0.31 per cent of water takes place.

Messrs. BOLAS and GLOVES communicated a paper on "Tetrabromide of Carbon."

This combination is obtained (1) by heating bisulphide of carbon with bromide of iodine, in a sealed tube, to a temperature of 150° C. for about 48 hours; (2) by heating bromopicrin with bromide of iodine in a flask furnished with a digestion-tube till the reaction is completed, which is indicated by the disappearance of the bromopicrin; (3) by heating bromoform with bromide of iodine, in a sealed tube, to about 150° C. for 24 hours.

In all the above processes, terbromide of antimony may be substituted for the bromide of iodine. The tetrabromide of carbon is obtained in a pure state by distillation. It is a white substance, crystallising in lustrous plates, melting at 91° C., of an ethereal odour, somewhat resembling that of carbon tetrachloride, and of sweetish taste. It does not dissolve in water, but readily in ether, hot alcohol (from which it is deposited, on cooling, in the crystalline state), carbon bisulphide, chloroform, bromoform, benzol, and American oil. Sodium amalgam reduces it to bromoform, and then into methylene dibromide.

The authors propose to carry on their investigations of this interesting compound.



## CORRESPONDENCE.

## MANUFACTURE OF SULPHURIC ACID.

*To the Editor of the Chemical News.*

SIR,—I cannot see how your correspondent "O. V." can have deduced from my letter the statement that "Mason's ores require much less nitre *per 100 parts of sulphur burnt* than do other ores. My statement was that 100 parts of sulphur (meaning pure brimstone) required, in the hands of different manufacturers, varying proportions of nitrate of soda; and I ventured the opinion that the variation was due to a want of uniformity in the conditions of the manufacturing process.

The subsequent mention of Mason's ores is accounted for by the absence of precise information as to whether Mr. Spence used brimstone or sulphur ores in his process.

I have had experience of Mason's ores, and find them very manageable; but, of course, the quantity of nitrate used with different ores of sulphur will vary in direct proportion to the quantity of sulphur they contain.—I am, &c.,

DAVID BASIL HEWITT, B.A., T.C.D.

Manchester, May 7th, 1870.

## MANUFACTURE OF SULPHURIC ACID.

*To the Editor of the Chemical News.*

SIR,—I transmit to you, herewith, copies of correspondence between Mr. P. Spence and myself, having reference to the papers which have recently appeared in your Journal relative to the production of sulphuric acid. Mr. Spence and I agree in thinking that the publication of the letters may serve to place the question under discussion in a clearer light.—I am, &c.,

J. W. KYNASTON, F.C.S.

St. Helen's, May 10th, 1870.

"St. Helen's,  
"April 29th, 1870.

"Dear Sir,—Will you pardon the liberty I take in addressing you? but I have been very much interested in your account of your trial of Dr. P. W. Hofmann's suggestions as regards the economical production of sulphuric acid. As I read Dr. Hofmann's original paper, and his subsequent letter seems to confirm this view, the important point in his improvement is that the mixed sulphurous and nitrous acid gases should not be permitted to come in contact with vitriol of lower strength than 143° Twad. until a reaction has taken place between them, and that, if it should come in contact with acid of a lower density, a large proportion of the nitrous acid is decomposed, with production of free nitrogen. If this be a correct conclusion, it appears to me that your re-arranged plan of working (as described in the CHEMICAL NEWS for April 22nd) introduces the very evil Dr. Hofmann tells us we should avoid. The difficulty under which I labour in my study of the matter is that, notwithstanding this, you have actually succeeded in reducing considerably your consumption of nitrate, and that you, with your great practical experience, consider the saving to be due to your having adopted Dr. Hofmann's suggestion. Though I have myself paid much attention to this manufacture, I yet feel considerable diffidence in writing to you that the diminution in your requirements of nitrate of soda is owing to quite another cause, or perhaps more than one. But I suggest to you whether, in your plan of working, as described in the before-mentioned paper, you are not condensing a considerable proportion of your make of vitriol in the first two chambers, and that your two next

chambers, while, of course, allowing the formation of more vitriol, play more distinctly the part of a Gay-Lussac's column or tower, the strong vitriol absorbing the nitrous gas, which, the vitriol being returned to the first chamber, is again evolved, and again becomes available for the same work as it had before performed. I have a strong opinion that the whole saving you have effected, and, I may add, the whole saving you expect to accomplish when your re-arrangements are complete, may be accounted for in this way alone, and without any consideration of Dr. Hofmann's suggestion. I should feel greatly obliged if you would favour me with your opinion upon the points I have called in question. To anyone engaged in the manufacture, economy in the use of nitrate is of the utmost importance; and I plead my anxiety on the subject as my excuse for troubling you with so long a letter.—I am, yours faithfully, J. W. KYNASTON.

"Peter Spence, Esq."

(REPLY).

"Manchester,  
"2nd May, 1870.

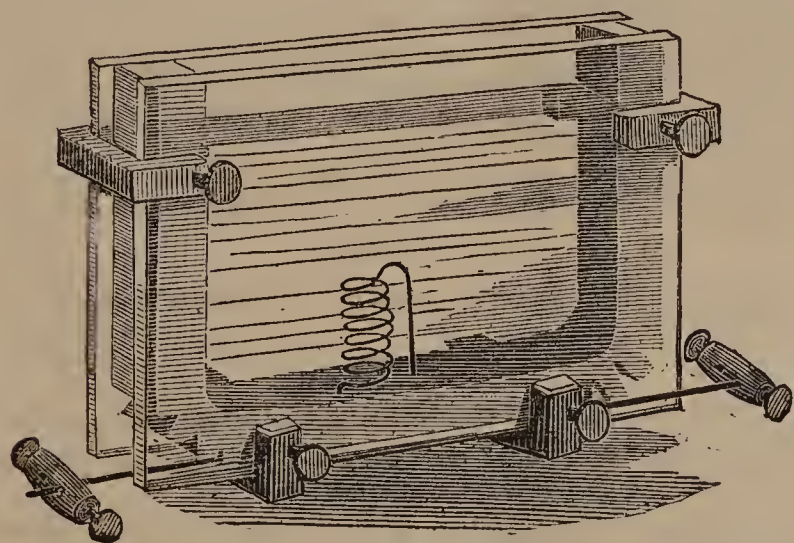
"Dear Sir,—I have much pleasure in answering your letter of 29th, to hand this morning. I am always ready to pick up any promise of improvement in the manufacture of sulphuric acid, and most ready to communicate all I know upon the subject. I therefore took up at once Mr. Hofmann's suggestion, and, although I did not, and do not now, believe in his theory, it at once suggested to me what you exactly describe as, in fact, the Gay-Lussac tower in principle, but without the apparatus. The theory of sulphuric acid production, as well as the facts of the Gay-Lussac process, in my opinion, disprove Mr. Hofmann's hypothesis. The theory is that the SO<sub>2</sub> and NO<sub>4</sub> unite to form sulphate of nitric oxide, which, by water or steam, is resolved into SO<sub>3</sub>HO and binoxide of nitrogen, which, in contact with air, instantly forms NO<sub>4</sub> ready for a repetition of the process. Now, not one-tenth of NO<sub>4</sub> is sent into the chambers equivalent to combine with all the SO<sub>2</sub> going in at the same time: the combination must, then, be made at least ten times (I should probably be more correct by saying twenty times, but ten is sufficient). If, then, 10 per cent of the nitric oxide is destroyed each combination, it would all be destroyed when the process is completed. Yet I have seen the Gay-Lussac process at work when, after, I think, ten chambers had been traversed, it took up so much of the binoxide of nitrogen that only one-fourth of the usual amount of nitrate of soda was required. Now, the Gay-Lussac process is not perfect, and probably one-fourth would escape its operation. No decomposition into nitrogen can therefore take place. I have little doubt Mr. Hofmann's first chamber would act by the strong acid at bottom reacting upon his gases, and affording them NO<sub>4</sub>. I am sorry I cannot as yet give you any decided results as to full success from the adoption of my scheme in its integrity. I only got all the connections made in the end of the week, and to-day my two strong chambers are getting up to the point I shall keep them at, namely, 143° Twad.; but, so far, I see no reason to doubt that at least a considerable saving of nitrate will be effected, and more than the practical trial gave me. I probably gave Mr. Hofmann more credit than I should have done, as I never believed his theory; but it was entirely to his suggestion that my effort was due, and in that case I could not claim as an originator, but merely as improving upon a suggestion. I may say that a very large production of acid takes place in my No. 1 chamber; but my No. 2 and 3 also produce largely, and all their production is now going into No. 1 loaded with NO<sub>2</sub>, and is taken out of No. 1 for use with almost no nitric oxide in it, or not more than I have usually had. If I can effect the expected saving, my only difficulty will be wear and tear of lead.—Yours very truly, (Signed) PETER SPENCE.



## MISCELLANEOUS.

**The Royal Society.**—The following gentlemen are recommended by the Council for election into the Royal Society, on June 2nd:—William Froude, C.E.; Edward Headlam Greenhow, M.D.; James Jago, M.D.; Nevil Story Maskelyne, M.A.; Maxwell Tylden-Masters, M.D.; Alfred Newton, M.A.; Andrew Noble, Esq.; Captain Sherard Osborn, R.N.; Rev. Stephen Parkinson, B.D.; Captain Robert Mann Parsons, R.E.; William Henry Ransom, M.D.; Robert H. Scott, Esq.; George Frederic Verdon, C.B.; Augustus Voelcker, Ph.D.; Samuel Wilks, M.D.

**Solar Eclipses.**—Through the kindness of Prof. Henry Morton we are enabled to give a brief account of a lecture on the above subject given by him for the benefit of the Franklin Institute. We have before had occasion to refer to the popularity of this eminent lecturer, as well as to the enormous scale on which he conducts the most successful experiments; and the lecture on solar eclipses, which was demanded a second time, illustrated as it was with the most brilliant experiments, fully sustains the high reputation he has gained both in the old and new world. After describing experimentally the causes of an eclipse, the umbra and penumbra, the law of direction, the total eclipse, and the prominences, the lecturer proceeded to illustrate the formation of solar prominences by means of a tank and a coil of wire (see woodcut). The tank is



filled with water, and then a solution of cochineal is run in on the bottom with a pipette. A single flask cell excited with bichromate of potash and sulphuric acid is enough to determine the ascending current, which carries up the crimson solution in a very beautiful manner. By interrupting the circuit, the red prominence can be made to settle back, or topple over, so as to assume many of the forms actually observed. To erect the image on the screen, Professor Morton used one of Zentmayer's erecting prisms.\* Mr. J. N. Lockyer's drawings of solar prominences, pictures of the corona and its coruscation, illustrated by a new piece of apparatus for the lantern, and producing on an immense scale the beautiful effects shown by the chameleon top, were very clearly shown.

**Existence of Tin in California.**—At an exhibition of the agriculture, and manufacturing and mineral resources of California, held last year at San Francisco, sacks of ore, bars of tin-plate, of the heaviest quality, and utensils of every sort for domestic use, which were manufactured from Californian ore, were there collected. Many doubted and shook their heads at this display of a long-desired but unusual manifestation of riches; but, since then, additional information and additional specimens of ore have been forwarded to the United States General Land Office at Washington, and an average sample of the same has been submitted for analysis to the able and distinguished chemist and mineralogist Dr. F. A. Genth, who reports that it contains 13.37 per cent of tin. The black mineral in the ore is tourmaline (it contains boracic acid), and the

brownish red is the cassiterite. It is a highly-interesting occurrence, and the yield of tin is almost twice as much as the usual working ores of the tin-mines of Cornwall, England. The property is said to consist of 50,000 acres of mining lands; and over twenty openings have been effected, from all of which the ore is extracted—*Journal of the Franklin Institute*.

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

*Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

*Comptes Rendus des Séances de l'Académie des Sciences, May 2 1870.*

This number contains the following original papers relating to chemistry and collateral sciences:—

**Cause of the Electric Currents Produced by the Contact of Metals and Distilled Water.**—E. Becquerel.—The chief result arrived at by the author's experiments may be summarised thus:—The electrical effects produced by the contact of non-oxidisable metals and distilled water (chemically pure) are due, not to any special action of contact, but to the reaction of the water upon the gases condensed on the surface of these metals. The effects vary according to the molecular state of the metals and their temperature. As regards, however, the oxidisable metals, the electrical effects produced by heating them are due to the very slight layer of oxide adhering to their surface, whereby they are rendered positive towards the unreserved metallic surface.

**Observations on M. Croullebois's Paper "On the Index of Refraction of Water."**—J. Jamin.

**Reply to the Note of M. Renou "On the Latent Heat of Ice, as Deduced from the Experiments of Laplace and Lavoisier."**—J. Jamin.

**Crystalline Form and Optical Properties of a Combination of Protochloride of Platinum and Triethyl-Phosphine Analogous to Magnus's Salt.**—J. des Cloizeaux.

**Constitution of Luminous Spectra.**—Lecoq de Boisbaudran.—The author calls attention in this paper to the fact of the analogy which exists between the spectra of the isomeric compounds—for instance, the alkaline chlorides, bromides, and iodides. The author further observes that the following spectral groups, each containing three bodies, may be made up, each of which exhibits greater analogy mutually, than with the rest of the groups—

K	Ca	Cl
Rb	Sr	Br
Cs	Ba	I

**Researches on the Calorific Spectra.**—P. Desains.—Reserved for full translation.

**Observations on the Results Obtained by M. Croullebois, as regards the Index of Refraction of Water.**—A. Cornu.

**Combustibility of Diamonds, and the Effect of a High Temperature on these Gems.**—Prof. Morren.—The author, in a letter, first relates the following facts, as having given rise to his experiments:—A jeweller at Marseilles, an excellent workman, well up to his trade, was requested to enamel afresh the golden bearings of two large diamonds of great value, used as shirt buttons. Instead of taking off the diamonds, always a delicate operation, the jeweller, who had frequently executed such work previously, decided to enamel the gold while the diamonds were left on their bearings. Not happening to have charcoal at hand, the jeweller took coals for heating the muffle for enamelling, an operation which succeeded most perfectly; but, on taking the buttons from the muffle, the jewels had become perfectly black, and no amount of rubbing or friction restored them to their pristine state. The jeweller was, therefore, obliged to dismount the jewels, which looked like plumbago, and to send them to Paris, where, by the first touch of the lapidary's wheel, they became restored to their former beauty, while, curiously enough, their weight had not changed. The author, who, through the kindness of MM. Laurin, jewellers, at Marseilles, was enabled to experiment with several diamonds, placed these on a small platinum boat in a platinum tube, and tried the effect of a high temperature simultaneously with different gases. Heated in coal-gas, the gems become blackish, increase in weight, and are found to be coated with a strongly-adhesive layer of carbon, such as is deposited in gas retorts; in pure hydrogen, the gems may be heated almost to the melting-point of platinum without undergoing any change; heated in carbonic acid gas, the gems become dull and lose a little weight

\* *Journal of the Franklin Institute*, vol. liii., p. 407.



The carbonic acid gas was found to be dissociated into carbonic oxide and carbonic acid; this, the author found, was caused by the platinum and not by the diamond. When the diamond is placed in oxygen gas, and ignited, it continues to burn, but remains white, appearing as a piece of unpolished glass; the stone does not blacken, nor swell up, and, if it is free from flaws or cracks, does not divide asunder.

Process Suitable for Estimating the Rapport existing between the Dynamical Force Applied and the Quantity of Electricity Produced in Holtz's Machine.—E. Bouchotte.

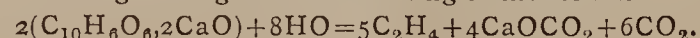
Solubility of the Chloride, Iodide, and Bromide of Silver in Salts of Mercury.—H. Debray.—The main gist of this paper is, that the insoluble chlorides, iodides, and bromides of silver, and also of mercury, are soluble, to a greater or less extent, in the soluble persalts of mercury, especially at a high temperature, and that, on cooling, some of these haloid salts crystallise; and in that state the chloride of silver perfectly resists the action of light, which the author attributes to the presence of traces of mercury.

New Method for the Volumetrical Estimation of Copper.—F. Weil.—This process is based on the two following facts:—(1) In the presence of free hydrochloric acid, and at a boiling heat, the very slightest trace of bichloride of copper present causes the liquid to assume a very marked yellow-greenish tinge, and this is the stronger the more hydrochloric acid is present. (2) Protochloride of tin causes, at that temperature, the immediate reduction of the salts of oxide of copper dissolved in hydrochloric acid to salts of the suboxide of copper, which, in solution, are absolutely colourless; the reaction takes place according to the formula  $2\text{CuCl} + \text{SnCl} = \text{Cu}_2\text{Cl} + \text{SnCl}_2$ . Any single drop of chloride of tin added in excess may be at once detected by the addition of a drop of a solution of corrosive sublimate (bichloride of mercury), which causes the formation of calomel. If the solution of copper contains iron also, the quantity of chloride of tin applied will indicate the joint quantities of iron and copper present.

Products of the Fermentation of Pyro-Tartaric Acid and its Homologues.—A. Béchamp.—Contrary to what, according to the author, might be expected, when pyro-tartaric acid ferments under the influence of the microzymas of chalk—viz., formation of butyric acid according to the formula—



the result obtained by actual experiment is, that no volatile acid is formed at all, and that only carbonate of lime remains; while carbonic acid and marsh gas are given off according to the formula—



Preparation of Pyro-Tartaric Acid.—A. Béchamp.—The author first thoroughly deprives of its water of crystallisation the tartaric acid to be submitted to dry distillation, next mixes that material with previously-ignited pumice-stone, and submits that mixture to dry distillation. In this way, 1600 grms. of tartaric acid yield 325 grms. of crude, but crystalline, pyro acid, which is best purified by means of alcohol of 90 per cent.

Minerals Found in the Cap Garonne (Département du Var) Copper Mine.—F. Pisani.—Among the many minerals here described the analysis of only one is given—viz., of adamine, a rather rare substance, first discovered in Chili. It consists, in 100 parts, of—Arsenic acid, 38.50; oxide of zinc, 52.50; oxide of cobalt, 3.92; water, 3.57. A cupriforous adamine was found to contain, also, in percentages—Arsenic acid, 39.85; oxide of zinc, 31.85; oxide of copper, 23.45; oxide of cobalt, 0.52; lime, 0.87; water, 3.68.

Observations on M. Duclaux's Paper "On the Formation of Drops of Liquids."—Dr. Limouzin.

Observations on the Effects of the Aurora Borealis of the 5th of April last on the Telegraphic Wires in the Ottoman Empire.—Dr. Lacoine.—The author describes, at length, the very peculiar effects alluded to, which, for a time, made all telegraphy quite impossible, owing to the counter currents excited in, or, at least, conducted by, the wires.

Death of Professor Lamé.—At the opening of the meeting, the President announced the death of Prof. Lamé, a member of the Institute since 1843. The deceased, a very celebrated physicist and mathematician, was born in 1795, educated at the Ecole Polytechnique, and was for some time engineer in the Russian service. On his return to France, he was appointed Professor of Physics at the above-named school, and remained in that capacity until the year 1845, when he was elected Examiner of the school. In the year 1848, he was appointed Professor of the Faculty of Sciences at Paris. Among his very many published works, those on mathematics and on the elasticity of bodies are the most celebrated.

*Revue Hebdomadaire de Chimie*, April 21, 1870.

Method for Extracting Sugar from Liquids which Contain that Substance, and its Combinations with Saline Matters.—M. Lair.—"Suppose," says the author, "any saccharine fluid: I add thereto lime in proper (but not specified) proportions, and heat to a temperature varying from 110° to 150° (under pressure, of course); by which proceeding saccharate of lime is precipitated, which is separated from the fluid either by filtration or decantation, and next treated by the ordinary well-known methods for the extraction of sugar from that lime-compound."

Application of Picric Acid for Imparting to Ivory, Bone, and Horn a Beautiful Red Colour.—C. Mène.—After giving a short account of the well-known properties of picric acid, the author describes the process alluded to as follows:—"Take 4 grms. of picric acid, and dissolve in 250 grms. of boiling water; add, after cooling"

8 grms. of liquid ammonia. Dissolve also 2 grms. of crystallised fuchsine (magenta) in 45 grms. of alcohol, dilute with 375 grms. of hot water, and next add 50 grms. of ammonia. As soon as the red colour of the magenta solution has disappeared, the two solutions are mixed together, making a bulk of liquid amounting to about  $\frac{1}{2}$  litre, which is a sufficient quantity for dyeing from four to six sheep's skins. Ivory and bone should be placed in very weak nitric or hydrochloric acids first, before being immersed in the ammoniacal liquid; wood cannot be dyed by this liquid, unless it has been previously painted over with paste made from flour. When, to the ammoniacal liquid, some gelatine solution be added it may serve as a red ink which does not attack steel pens. By varying the proportions of the magenta and picric acid, the tints obtained may be varied from a bluish red to a bright orange-red. The desired colours do not appear until the ammonia is evaporated.

Nickelisation.—M. Gaiffe.—This paper, illustrated by a woodcut, gives practical details about the method applied by the author for the coating of metals with a more or less thick adhesive layer of nickel.

Method for Obtaining a Regular Stream of Sulphuretted Hydrogen Gas from Black Sulphide of Antimony.—Dr. Méhu.—In many parts of France, and especially in the south thereof, sulphide of antimony is regularly used for the disengagement of sulphuretted hydrogen; of course, hydrochloric acid and heat have to be applied. In order to obtain a very regular current of that gas, the author advises to mix the pulverised sulphide with about one-third of its weight of quartz sand or powdered sandstone. The addition of this material, in the same proportion, to black oxide of manganese, when used along with hydrochloric acid, for the disengagement of chlorine, has the effect of rendering the evolution of that gas steady while, in both cases, heat may be freely applied to the retorts or flasks without fear of breaking them.

*Revue des Cours Scientifiques de la France et de l'Etranger*  
April 23, 1870.

This number does not contain any original papers relating to chemistry or physical sciences, but we notice—

Organisation of Universities.—Dr. Du Bois-Reymond.—A valuable contribution, setting forth what universities ought to be, and how the different systems adopted in France and Germany work for or against the advantage of the students.

Asphyxia by Carbonic Vapours.—Dr. Claude Bernard.—An interesting paper in a chemico-legal as well as physiological respect.

April 30, 1870.

This number does not contain any papers relating to chemistry or physical sciences.

*Bulletin Mensuel de la Société Chimique de Paris*, March, 1870.

From the *procès-verbaux* of the meetings of this Society, published in this number, we abstract the following:—

M. Fleury stated that he has obtained, from the white-coloured mushroom known as *Boletus laricis*, two peculiar substances, extracted by means of ether. One of these materials is a brown-coloured resin, insoluble in water, very readily soluble in ether, less so in alcohol of 70 per cent, but very soluble in pure methylic alcohol and chloroform, and insoluble in benzol and sulphide of carbon; this resin is not crystallisable, fuses at 89.7°, and is soluble in alkalis, from which solution it is precipitated by alcohol; it contains  $\text{C}_{51}\text{H}_{82}\text{O}_{10}$ , and its barium combination is  $\text{C}_{51}\text{H}_{82}\text{BaO}_{11}$ . The other substance, called agaricic acid,  $\text{C}_{16}\text{H}_{28}\text{O}_5$ , fuses at 145.7°, is readily soluble in strong alcohol less so in ether and acetic acid, and very difficultly soluble in water, to which, however, it imparts an acid reaction, perceptible by means of test-paper; this acid forms, with bases, salts; the silver salt is decomposed at 100°.

M. Berthelot communicated some of his researches on the oxidation of acetylen and allylen. The oxidising material employed is pure chromic acid free from any sulphuric acid. The energy of the action depends upon the degree of concentration of the chromic acid solution; if that solution is concentrated, formic and carbonic acids are chiefly formed from acetylen; but, if care be taken to cool down the mixture, acetic acid is formed, along with a small quantity of phenacetic acid. Allylen yields propionic acid, and, moreover, a compound containing  $\text{C}_6\text{H}_4\text{O}_2$ .

The following original papers are published in this number:—

New Method of Preparing Bromhydric Acid.—Drs. Champion and Pellet.—The authors first state that they tested two samples of bromhydric acid as now met with in commerce. The sp. gr. of one of these samples was 1.3, and it contained 0.3 gm. of real acid to the c.c.; the other sample had a sp. gr. of 1.12, and was found to contain 0.25 gm. of real acid to the c.c. The process proposed by the authors for the preparation of pure bromhydric acid by a rapid and safe process, is based upon the mutual reaction of the vapours of bromine and paraffin, as already quoted by us from the *Comptes Rendus* (see CHEMICAL NEWS, vol. xxi., p. 154).

Composition of Fossil Bones.—A. Scheurer-Kestner.—This rather lengthy paper contains the results of the author's researches, not simply on the composition of fossil bones, but also on the influence the soil in which they are found may have had in determining their more or less complete petrification. The soil (*lehm*, a kind of marl) in which the bones referred to were found was composed, in 100 parts



of—Hygroscopic water, 1.83; water driven off at red heat, 6.91; carbonate of lime, 28.19; carbonate of magnesia, 1.86; oxides of iron and alumina, 7.0; silica, 53.74; chloride of calcium, 0.31; sulphuric acid, 0.16. The paper contains a lengthy series of different analyses of fossil bones, as well as of bones, chiefly human, buried for centuries. The author states that his researches prove the fact that both these kinds of bones have undergone a similar alteration, because they both contain an organic matter, termed osseine, which is insoluble in water, and, in addition thereto, another nitrogenous organic matter, derived from the last-named and soluble in water. The slow decomposition which bones undergo depends upon the physical conditions, as well as the chemical composition, of the soil wherein they are deposited; but, as regards bones met with in the same geological formation, and buried together, chemical analysis, as proved by the author, can ascertain the age of such bones.

**Preliminary Notice on a New Pigment met with in Bile.**—E. Ritter.—The author states that he has obtained, from bile, a blue-coloured material, insoluble in chloroform and acids. Its alkaline solution is colourless, or yellowish; it is a substance which resembles indigo to some extent, but differs from it by the fact that its alkaline-glucosic solution, after having been neutralised with an acid, deposits, on being exposed to air, a brown-coloured compound, which does not become blue again until after some length of time, whereas indigo, under the same conditions, re-assumes its blue colour directly. This blue pigment is obtained from bile after first filtering it, and next shaking it with chloroform. The solution thus obtained is next treated with a very weak solution of caustic soda; and, after having been neutralised with hydrochloric acid, applied in slight excess, the acid solution will contain the blue matter in state of suspension.

**Heat Disengaged by the Combination of Boron and Silicium with Chlorine and Oxygen.**—L. Troost and P. Hautefeuille.—This very lengthy essay is divided into the following chapters:—Heat disengaged during the combination of boron with chlorine and oxygen; heat disengaged during the combination of silicium with chlorine and oxygen; applications to metallurgy.

**Iodo-Mercurate of Copper.**—Drs. Willm and Caventon.—The material alluded to, which appears to contain  $\text{HgCu}_2\text{I}_4$ , behaves as if it were composed of  $\text{HgI}_2 \cdot (\text{Cu}_2\text{I})_2$ ; its colour is vermilion at the ordinary temperature, but brown at  $100^\circ$ . When this compound is boiled with ammonia, a portion of the mercury separates. This iodo-mercurate of copper is produced by the action of iodo-mercurate of potassium upon sulphate of copper.

*Berichte der Deutschen Chemischen Gesellschaft zu Berlin*, No. 6, 1870.

This number contains the following original papers and memoirs:—

**By-Products Accompanying the Preparation of Chloral on the Large Scale.**—G. Kraemer.—The author has fully investigated the by-products just alluded to, and describes, in a lengthy paper, the following substances:—Chlorinated chlorethyliden-chlorethyliden; ethylen-dichloride; chlorinated ethylen-dichloride; double (*zweifach*) chlorinated ethylen.

**New Method of Formation of Collidine.**—G. Kraemer.—Collidine is an alkaloid found in the products of the dry distillation of animal substances, and some kinds of coal and bituminous scales; it is isomeric with ethyl-phenylamine, ethyl-picoline, and other bodies. The author, in this paper, describes, at length, a mode of preparation of this substance from chlorethyliden and chlorethyl, by means of an alcoholic solution of ammonia; and enclosing these substances in sealed tubes kept at a temperature of  $160^\circ$ . After a process of rectification and purification, the author obtained the body above named,  $\text{C}_8\text{H}_{11}\text{N}$ , and enters into a very lengthy theoretical discussion about its formation in this instance.

**On Substituted Melamines.**—Dr. A. W. Hofmann.—It is not easy to give any useful abstract of this valuable paper with due regard to its intrinsic merits and the high standing of the eminent author.

**Bodies Isomeric with Cyanuric Ether.**—Dr. A. W. Hofmann and J. O. Olshausen.—This very lengthy essay is divided into the following sections:—Experiments in the methyl series, cyanuric methyl-ether; dimethyl-ether of amido-cyanuric acid; experiments in the ethyl series; diethyl-ether of amido-cyanuric acid; ethyl ether of diamido-cyanuric acid; experiments in the amyl series; experiments in the phenyl series.

**Phosphates of Thallium, and their Isomorphism with other Phosphates.**—C. Rammelsberg.—This paper is chiefly an essay on the crystallography of the salts alluded to.

**On Bryonicine.**—L. de Koninck and P. C. Marquart.—After briefly alluding to the older researches on the constituents of the tubers of the *Bryonia dioica*, a poisonous plant growing wild in Central Europe, the authors state that they obtained the body, named by them, bryonicine, from the well-known Dr. Marquart's chemical factory, at Bonn, where this bryonicine had been obtained as a by-product of bryonine. Bryonicine is a neutral substance, exhibiting crystalline structure; its colour is feebly yellow; it is insoluble in cold water, solution of caustic potassa, ammonia, and dilute mineral acids. Boiling water and boiling concentrated hydrochloric acid dissolve a small quantity of bryonicine, but, on the cooling of these fluids, it separates again; alcohol, ether, chloroform, benzol, sulphide of carbon, glacial acetic acid, and concentrated sulphuric acid dissolve bryonicine very readily. The solution of bryonicine in concentrated sulphuric acid is blood-red coloured; water precipitates the solutions of this body in acetic and sulphuric acids; its alcoholic solution is not precipitated by tannine,

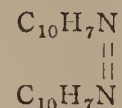
nor, also, by the neutral and basic solutions of acetate of lead. Bryonicine fuses at  $56^\circ$ , and sublimes at a higher temperature without decomposition. It is not a glucoside; its formula is  $\text{C}_{10}\text{H}_7\text{NO}_2$ .

**On Poly-Bromides and Tetrammonium Bases.**—P. C. Marquart.

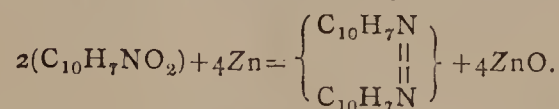
**Newly-Contrived Suction Apparatus and a New Alkali Apparatus.**—L. de Koninck.

**Contribution to the History of Naphthylamine.**—M. Ballo.

**Action of Zinc Dust on Nitro-Naphthaline.**—W. H. Doer.—Among the products of the action of finely-pulverised zinc, the author found azonaphthaline—



which is formed according to the following formulæ:—



**Some of the Colouring Matters contained in Madder.**—F. Rochleder.—Reserved for full translation.

**Account of the Electrolysis of some Chemical Compounds.**—N. Bunge.—Illustrated with woodcuts.

**Researches on the Derivatives from Glycerine.**—L. Henry.—This lengthy paper is so filled with formulæ, some of them occupying about half a page, that it is quite impossible to make any useful abstract of it.

**Schiel's Chloral-Uric Acid.**—N. Lubavin.—A critical review of Schiel's labours on this subject.

**Action of Sodium on Acetic Ether.**—A. Ladenberg.

**Bicarbonate of Ammonium in the Coal-Gas at Munich.**—Dr. A. Vogel.—The author states that, as far back as the year 1852, he had discovered the presence of bicarbonate of ammonium in coal-gas, and also detected, in the crystals of that substance, traces of iodine and sulpho-cyanogen. The discovery, therefore, made by Dr. Rudorff, on this subject, at Berlin, last winter, is not new; and a paper on this matter was read by the author at one of the meetings of the Royal Academy of Sciences at Munich.

This number contains lengthy reports from the correspondents of this Society at Prague, Cambridge (U.S.), Lund (Sweden), Paris, and London; but we do not give any abstracts from these reports, as our readers are already acquainted with most of them, by our abstracts from the *Comptes Rendus* and other papers.

*Les Mondes*, April 28, 1870.

**Improved Method for the Preservation of Eggs.**—S. Martin.—The author reviews, first, the various methods now in use for the proper preservation of eggs for any length of time, and discusses the value of these methods; and, further, proposes the use of collodion as a fit varnish by means of which the cause of the decay of the eggs—viz., the porosity of the shell, and, hence, access of air to the interior, may be prevented. The author also mentions that the soundness of eggs may be tested by immersing them in water containing 30 per cent of common salt in solution; in this brine, good and sound eggs sink while bad eggs float. Lastly, the author makes the very important statement, that a chemist (not specified or named) has just discovered a process whereby the albumin of the blood of butchered animals may be obtained in completely colourless state, so as to render it a fit substitute for the very large quantity of dried albumin from eggs now employed, especially in calico printing. It is a pity that this statement is not more explicitly made, and the method described.

**Economical Production of Petroleum Gas, and on a Newly-Contrived Retort for its Production.**—F. Boital.—The author describes, at length, and elucidates by means of woodcuts, his process for the manufacture of illuminating gas from the residues of petroleum distillation. It appears that this mode of gas manufacture is rapidly extending on the Continent. The expense of establishing works for this purpose is very much less than for coal gas; and, moreover, the gas obtained is free from ammoniacal and sulphurous products.

**New Method of Hanging Bells in Towers and Church Steeples.**—Rev. Equillon.—By this plan, the strain occasioned by the oscillation of the bells while being rung is entirely thrown off the walls or supports of the structure in which they are placed, by the adoption of a method of hanging described by the author and illustrated by diagrams.

**Rotatory Skeleton Pump.**—E. Ganneron.—A peculiar contrivance, elucidated with a woodcut.

**New Work on Analytical Chemistry.**—The excellent editor of *Les Mondes* highly eulogises the great merits of the second edition of "Précis d'Analyse Chimique Qualitative," par Gustave Chancel, Ph.D., &c., Doyen de la Faculté des Sciences de Montpellier. This work is very highly appreciated wherever, on the Continent, French is read, and is one of the best books of its kind.

May 5, 1870.

This number does not contain any original papers or communications relating to chemistry or collateral sciences.



Cosmos, April 30, 1870.

Geology of the Soil which had been Gradually Deposited on, and Covered over, the now recovered Ancient Amphitheatre at Paris.—Dr. Virlet d'Aoust.—A curious and interesting contribution to the daily, but permanently, occurring changes of the surface of our globe, even in inhabited localities.

Has the Sea (Mediterranean) ever been quite Close to Aigues-Mortes?—Dr. L'Hôte.—Many of our readers have, perhaps, while visiting the south of France, paid a visit to that curious remnant of the middle ages, and celebrated small town in the history of the Crusades, named Aigues-Mortes (Département du Gard). At present there is a distance of several kilometres between the walls of that town and the shores of the Mediterranean. The assertion has very generally been made, that the land now existing between the town and the sea has been gradually formed since the time St. Louis, King of France, embarked at Aigues-Mortes for the conquest of Palestine, in the 13th century. The author's researches, and the discovery of stone-made structures on the land alluded to, which are proved to be of undoubtedly older date than the town itself, taken in connection with the fact that there also exists ancient documentary evidence, of undisputed authority, of the existence of a deep harbour leading from the town to the sea, entirely disprove the old assertion, above alluded to; while, moreover, as additional evidence on this point, the fact is brought forward that the littoral of nearly all the departments of France bordering on the Mediterranean presents similar features, to a greater or less extent, the same as those met with between Aigues-Mortes and the sea.

## NOTES AND QUERIES.

**Soap Making.**—I am informed that soap makers prefer tallow to stearic acid for soap making, and that fire-rendered tallow is preferred to steam-rendered. I have looked through the works of Muspratt, Watts, Ure, and others, but can find no notice of these things; will any of your practical readers oblige by stating if such is the case, and if so, explain the reasons for it?—SAFO.

**Water Analysis.**—(Reply to "H. O.")—For a simple practical method, see Fresenius's "Quantitative Analysis," p. 273, new edition. No mention is made of the estimation of organic matter, as this branch is in so unsatisfactory a condition. The total organic matter cannot be nicely estimated, even if it is worth estimating; and as to that portion which is injurious, our knowledge simply amounts to a guess that it contains nitrogen.—A. V.

**Water Analysis and Wood-Paper.**—My attention has just been called to your Query column, "H. O." and "A. B. C." being desirous of obtaining information relative to my investigations on water analysis and wood paper. "H. O." will find the process for water in CHEMICAL NEWS, vol. xii., p. 87, signed "R. C. M." I understand that it is now employed in several laboratories. As is mentioned in the paper, the advantages of the process are the solubility of the chlorides alone in alcohol, the solution of the sulphates in water, and the carbonates, &c., in acid. "A. B. C." is desired to communicate.—R. CARTER MOFFAT.

**Gas Furnace.**—(Answer to "B. C. J.")—I have used Griffin's combustion furnace for some time past, and find it very convenient. The gas is burnt at a row of Bunsen's, and the tube is packed in movable fire-clay bricks with "zig-zag" edges. To prevent the direct action of the flames on the bottom of the tube, I usually rest it on a bed of asbestos contained in a narrow sheet-iron trough. The furnace is fully described in Griffin's "Chemical Handicraft" (p. 103)—A. V.

**Valuation of Gas Coal.**—Can you give me any information on the subject of the valuation of coal (Cannel), more particularly with reference to the estimation of the available gas. The subject is one not treated in works on analysis, so far as I am aware. Can a method of distillation in an atmosphere of CO<sub>2</sub> be adopted, washing the gas evolved by solution of potassa, and measuring over water, as in nitrogen determinations? The difficulty I apprehend will be that the distillation of the coal will be irregular, the amount of the gas being greater, and the tar oils less, according as the heat is quickly or slowly applied. I have made a few experiments as above, and my results do not accord, which I attribute to the irregular distillation. Is this likely to be the cause?—P. H.

## MEETINGS FOR THE WEEK.

MONDAY, 16th.—London Institution, 4.

TUESDAY, 17th.—Institution of Civil Engineers, 8.

—Royal Institution, 3. Prof. Blackie, "Principles of Moral Philosophy."

WEDNESDAY, 18th.—Society of Arts, 8.

—Pharmaceutical, 8. Anniversary Meeting, 11 a.m.

THURSDAY, 19th.—Royal, 8.30.

—Zoological, 4.

—Royal Institution, 3. Prof. Tyndall, "On Electricity."

—Chemical, 8. W. H. Perkin, F.R.S., "On Some Derivatives of Coumarine."

FRIDAY, 20th.—Royal Institution, 8. Prof. Williamson, "On Atoms."

SATURDAY, 21st.—Royal Institution, 3. Prof. Grant, "Astronomy of Comets."

## CHEMISTRY CHAIR IN ANDERSON'S UNIVERSITY.

TO THE TRUSTEES AND MANAGERS.

Gentlemen,—As a Professor to fill the present vacant Chair of Chemistry in Anderson's University is likely soon to be appointed, and as it is my intention to become a Candidate, I take the liberty of addressing a few statements to you as preliminary to sending in testimonials, &c.

I at present hold the appointments of Lecturer on Chemistry to the Glasgow Mechanics' Institution and Professor of Chemistry in the Glasgow Veterinary College. The former I received upwards of four years ago, when five candidates came forward; and the latter appointment I obtained, also four years ago, on the recommendation of the late Professor Penny, who was for many years chemical teacher in both institutions—and on his resignation of the Professorship in the Veterinary College, it was mainly through him that I was appointed in his place.

About five years ago, the Faculty of Physicians and Surgeons of this city deputed two of its members to report on my Chemical capabilities; and the result was a grant from that body recognising my lectures and practical classes as qualifying for examination before their board, and all other boards, &c., which recognise the Chemical teacher's certificates of Anderson's University.

I received my Chemical training in Edinburgh College of Surgeons, under Dr. Macadam, where I remained upwards of seven years. During much of that time I was Senior Assistant and Demonstrator, and had charge of large classes of both medical and manufacturing students. The analyses of medical and technical products were made daily by me in Dr. Macadam's laboratory.

On my coming to Glasgow to open a laboratory of my own, which I did in Ingram Street, I found the field of work extensive enough, but so well taken up by other Chemists that little could be accomplished for a year. My appointments to the Mechanics' Institution and Veterinary College, as Chemical teacher, opened a road; and by no small amount of energy and perseverance I have now the satisfaction of possessing the largest Practical Chemistry Classes in the city.

I have lectured daily, and held practical classes, in my laboratory and lecture-rooms and out of them, for five years, since I came to Glasgow. As you are already aware, I have expended large sums of money in fitting up my laboratories, &c., with apparatus suitable to the advancement of classes in Technical Chemistry.

The number of medical students who have attended my lectures and classes has been considerable, and at the present time at the Practical Medical Class there are twenty-one students. This number, when it is remembered the disadvantages the additional teacher must be under, who is some distance from the Andersonian, is highly gratifying.

It is out of place at this time to refer to personal scientific researches and discoveries; but, as indicating that I have not been backward in adding to Chemical facts, I may mention Oleography, Water Analysis, Free Sulphuric Acid, Manure Analysis, Detection of Strychnine, Blood Stains, Wood Paper, as some amongst my original investigations.

The departments of Scientific, Medical, and Technical Chemistry occupy my entire attention, and perhaps the best evidence of work done satisfactorily is in the fact of having enrolled, during three sessions, upwards of 500 practical students, and these at fees considerably higher than at any laboratory in the city; while the number of lecture students was 313. These numbers chiefly represent manufacturing students.

Should I have the honour to be elected by you, I shall endeavour to hold the appointment with acceptance.

I beg to place before you these statements, and I shall consider it a great favour to have your support at the time of the appointment.

I am, Gentlemen, yours respectfully,

R. CARTER MOFFAT, PH.D.

Analytical Laboratory, and School of Technical  
and Medical Chemistry,  
Mechanics' Institution, 38, Bath Street, Glasgow.

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# THE CHEMICAL NEWS.

VOL. XXI. No. 547.

## GOLD REFINING BY CHLORINE GAS.\*

By F. B. MILLER, F.C.S.,  
Assayer in the Sydney Branch of the Royal Mint.

THERE is no recorded instance of gold having been found in an absolutely pure state. Every natural alloy of gold (or native gold, as it is called by mineralogists) contains more or less silver; and in almost all bullion resulting from the melting of Australian alluvial gold, the portion that is not gold consists chiefly of silver, with only a very small proportion of foreign metals, usually copper and iron, with occasionally a little lead or antimony, and sometimes a trace of tin, iridium, &c. This, however, though true generally, is not always the case with gold obtained from quartz veins by amalgamation, as the mercury occasionally reduces and takes up other metals, as well as the gold, which appear in the bullion on melting. The accompanying table will give some idea of the proportion of the precious metals contained in the gold from the various districts of New South Wales after melting. It will be seen that the most argentiferous is that from Boonoo Boonoo, in the north, containing as much as 34 per cent of silver. This approaches, in composition, the gold from the productive Thames district of New Zealand; while the gold from Nerrigundah, in the south, only contains 1.5 per cent of silver, the remaining 98.5 per cent being gold with a trace of copper.

Table showing the Proportion of Gold and Silver, in characteristic samples of Gold-Dust, from various localities in New South Wales (after melting).

	Locality.	Gold in 1000 parts.	Silver in 1000 parts.
Northern.	Boonoo Boonoo .. ..	654 to 695	337 to 298
	Fairfield .. ..	872	121
	Timbarra .. ..	708 to 898	280 to 97
	Peel River .. ..	929	67
	Rocky River .. ..	934 to 962	61 to 33
Western.	Nundle .. ..	923 to 937	66 to 63
	Bathurst .. ..	827 to 903	164 to 92
	Sofala .. ..	929 to 933	66 to 63
	Tuena .. ..	943	54
	Ophir .. ..	915	82
	Tambaroora .. ..	943 to 954	54 to 42
	Turon .. ..	918 to 928	78 to 68
Southern.	Hargraves .. ..	915	83
	Windeyer .. ..	946 to 959	53 to 37
	Burrangong .. ..	948	48
	Adelong .. ..	946 to 951	52 to 45
	Braidwood .. ..	928 to 934	67 to 62
	Emu Creek .. ..	971	27
	Delegate .. ..	971	27
	Nerrigundah .. ..	983	15

An interesting, and as yet unanswered, question here arises—Is this argentiferous character in any way connected with the geological structure of the district?

It is a fact, and certainly a very curious one, whether it arises from accidental causes, or whether it may hereafter be traced to peculiarity in the rocks whence the gold of the different districts is derived, that its quality or fineness deteriorates the farther north we go; in other words, it contains more silver and less gold.

Thus, the average fineness of Victorian gold is about 23 carats—that is to say, it contains about 96 per cent of gold and 3½ of silver, with ½ a per cent of base metals; while, on passing north, we find the average fineness of New South Wales gold to be only 22 carats 1½ grain, or to contain 93½ per cent of gold and 6 per cent of silver. On going still farther north, to the colony of Queensland, the average fineness is little more than 21 carats (considerably below standard), or it contains 87½ per cent of gold and 12 per cent of silver; that from Maryborough containing as much as 14 per cent of silver and only 85 per cent of gold.

These are averages only. It is not to be supposed that there is a regular and consecutive diminution in fineness with every degree of latitude we go north. There are exceptional localities in the north of this colony, where the gold found is of a high degree of purity, as at Rocky River, where it is over 23 carats fine, or 96 per cent.

Possibly, at a future time, our geologists may be able to throw some light on these curious facts, and the exceptional cases may, then, even help in explaining the apparently general rule.

The point, however, of principal interest, as far as regards the subject of this paper, consists in the fact that, as the alloy obtained by the gold miner is poorer in gold, it is proportionally richer in silver.

According to the published returns, 6,820,198 ozs. of gold have been received for coinage in the Sydney Mint between its establishment, in May, 1855, and December 31, 1868.

The average assay of this quantity would be about 943. In other words, it contained 94½ per cent of gold, 5 per cent of silver, and ½ per cent of base metals.

Allowing an average loss of 2 per cent in melting the gold dust, there would remain, after smelting, 6,683,795 ozs. of gold bullion; and, as the silver it contained amounted to 5 per cent of this quantity, the gross amount of silver in the gold received for coinage was 334,190 ozs.; being at the rate of 24.750 ozs. per annum.

The average proportional quantity of silver contained in the gold arriving in Sydney is at present very much greater than that given above, owing to the large amount of silvery gold now being found, especially in the neighbouring colony of Queensland, and for the year 1868 was not less than 36,000 ozs. (£9150), and was probably (including that in the gold shipped direct as bullion by the banks) nearer 42,000 ozs.

Most of the silver thus naturally present in the gold has hitherto been lost to the colony, owing to the expense, in Sydney, of the acids, &c., necessary for its extraction by any of the usual methods of refining, which left little, if any, margin of profit on the operation. It therefore seemed desirable that some easy and economical process should be contrived for refining, in Australia, without the aid of costly plant and chemicals.

Twelve months ago, a paper of mine, describing a new process for refining and toughening gold by means of chlorine gas, was read before the Chemical Society, London. As, since the publication of that paper, the method of refining therein proposed has been successfully brought into practical operation on a large scale, both here and in New Zealand, and there is a probability that its adoption will, before long, become more general, I lay before the members of this Society a somewhat detailed account of the process, and some of its more striking results.

I shall, as far as possible, avoid giving the details of the preliminary experiments which lead to the practical application of the process, and which have already been published in the *Journal of the Chemical Society*;\* but, in order to render myself intelligible, some repetition of what is therein contained will be necessary.

Most people at all interested in the matter are aware that the ordinary method of separating silver from natural alloys of that metal and gold is a complicated and expen-

\* Read before the Royal Society of Victoria.

\* See also CHEMICAL NEWS, vol. xviii., p. 234.



sive process, and that the end is attained by melting the gold with at least  $2\frac{1}{2}$  times its own weight of silver, and then again separating, by the action of acids, the silver thus added, and also, at the same time, the small quantity originally contained in the gold, thus leaving, as a residue, fine gold assaying from 990 to 993; the *rationale* of the operation being this:—If the natural alloy were simply placed in the acid, the very large excess of gold in the alloy would completely protect the silver it contained from the action of the acid; but, if the gold is melted with a large excess of silver, so that the silver greatly preponderates over the gold in the alloy treated, then the acid is able to exert its solvent action not only on the silver thus added, but also on that originally contained in the gold. To arrive at this end, a complicated and very costly plant is required, besides large quantities of expensive acids; and several days are occupied in the operation. It is evident, then, that, if all this complicated process can be avoided, and the silver simply and completely separated in one operation at the time the gold is being melted, a very great saving of time, of material, of plant, and of the interest involved in all these, will be effected.

Such an end is attained in the plan now being adopted for effecting this operation.

It is well known that chlorine readily enters into combination with almost every known metal, the action, in some cases, being so violent as to be attended with vivid combustion. Many metals, such as lead, tin, zinc, and antimony, when introduced into this gas, even at ordinary temperatures, combine with it, forming highly-volatile chlorides. The two latter, if in a state of fine division, burst into flame on being placed in an atmosphere of chlorine.

Copper also exhibits spontaneous combustion under similar circumstances, but the resulting chloride formed is only slightly volatile.

Silver, immersed in chlorine gas at ordinary temperatures slowly unites with it, forming chloride of silver; but, if the gas be passed over it while red-hot, the action is much more energetic, the compound formed being more volatile than the chloride of copper, but much less so than those of lead, tin, zinc, or antimony.

The method of refining now to be described is based upon these facts.

It consists simply in passing a current of chlorine gas through the gold *while in a melted state*, which is easily done by thrusting into the molten metal a small clay tube connected with a stoneware vessel in which chlorine is generated.

The chlorine, on coming in contact with the silver in the molten alloy, at once combines with it, forming chloride of silver, which, being of less specific gravity, rises to the surface of the melted gold, while this latter remains in a purified condition beneath.

Chloride of silver has always been considered a somewhat volatile substance, and, under circumstances such as those here described, it was naturally supposed that it would either be sublimed in the flue or escape entirely up the chimney; but, in practice, it is found that the volatility of the chloride is not nearly so great as might have been anticipated, and that, if its surface is coated with a layer of fused borax, it may be kept melted at a high temperature, without any very material loss.

The furnace required for the operation is the ordinary 12-inch square gold-melting furnace, the principal points to attend to in its construction being (1) that the flue should be as near the top as possible, so as to allow of the crucible standing high up in it without being cooled by the draught, and (2) that the furnace itself should not be too deep, so that, when the pot is placed in the fire, the bottom of it may not be more than 3 inches above the bars.

The covering of the furnace should consist of two fire-tiles,  $7\frac{1}{2}$  inches wide and 15 inches long, one of which should have a long slot or hole in its centre, for the clay

chlorine-pipes (which I shall describe presently) to pass through. An iron cover will not answer, as it soon becomes much too hot for convenient working.

The crucibles in which the refining is performed should be French white fluxing-pots (*creusets de Paris*, made by De Ruelle, late Payen, Paris); ordinary black-lead pots will not answer, owing to the reducing action they exert on the compounds formed. To prevent the infiltration of the very fluid chloride of silver into the pores of the clay pots (which would otherwise occur, and necessarily entail loss), they are prepared by filling them with a boiling saturated solution of borax in water, which is allowed to stand in them for ten minutes, and is then poured off, the crucibles being afterwards set aside to dry: the borax forms glaze on the inner surface of the crucibles when they become hot in the furnace.

When used for refining, these French clay crucibles are placed within black-lead pots, as a precaution against loss, should the former crack, which, however, seldom happens. The crucibles are covered with loosely-fitting lids, with the requisite holes bored through them for the passage of the clay chlorine-pipes, &c. Ordinary clay tobacco-pipe stems, from 17 to 22 inches long, have been found to answer well for the purpose of passing the chlorine gas through the melted gold. Of late, a pipe made in London to order,  $\frac{1}{4}$  inch in diameter, 22 inches long, and 3-16-inch bore, has been found to answer all requirements. The chlorine-generators should consist of the best glazed stoneware acid-jars, capable of holding from 10 to 15 gallons, and furnished with two necks. One of these openings should be stopped with a sound cork (or vulcanised india-rubber plug, if obtainable), through which should pass tightly two glass tubes, the eduction-tube and the safety or pressure tube, the length of the former being a few inches, and the latter 8 or 10 feet, spliced, where necessary, by means of vulcanised india-rubber tubing. The other opening, intended for introducing the oxide of manganese, &c., should be closed with a leaden plug, covered with a short piece of india-rubber tube by way of a washer, and well secured.

Each generator should be charged with a draining-layer of small quartz-pebbles, down nearly to the bottom of which the pressure-tube should extend. On this layer should be placed from 70 to 100 lbs. weight of binoxide of manganese, in grains about  $\frac{1}{4}$ -inch cube, sifted from powder; this quantity will be sufficient to effect many refining operations, and will obviate the necessity of repeated dismantling of the apparatus.

Each generator should be suspended to about half its height in a galvanised-iron water-bath.

The chlorine gas is produced, when required, by pouring common hydrochloric acid (sp. gr., 1.15) down the safety-tube, the apparatus being warmed by means of gas-burners beneath the water-baths. The gas is conveyed from the generators by means of a leaden pipe fitted with branches to supply the several furnaces, all intermediate connections being formed by means of vulcanised india-rubber tubing, which, if screened from the direct radiation from the fire, stands the heat well, even immediately over the furnaces. All joints between the various pipes and india-rubber tubes are easily secured, and rendered perfectly gas-tight, with a cement consisting of a thin solution of india-rubber in chloroform.

Screw compression-clamps on the india-rubber tubes give the means of regulating the supply of gas as required, and enable the operator to shut it off entirely as soon as the refining is over. The chlorine then, having no means of escape, accumulates in the generator, and soon forces all the acid up the safety-tube into a vessel placed above to receive it, and, the acid no longer acting on the oxide of manganese, the supply of gas of course ceases.

These generators are very convenient and manageable, and it is questionable whether a gas-holder for the chlorine (even if the practical difficulties in its use could be overcome) would be at all preferable. Two such generators



as are here described, and three ordinary gold-melting furnaces, have been found capable of refining daily about 2000 ounces of gold containing about 10 per cent of silver, between 9 a.m. and 2 p.m.

(To be continued.)

## ON WHEAT AND WHEATEN BREAD.

By M. H. MEGE-MOURIES.

It will be remembered that, since 1855, my studies respecting the chemical action of organic tissues have been applied to the important subject of bread, and that the following facts have been ascertained:—1. That brown bread contains colouring matter, lactic acid, glucose, dextrine, &c., proceeding from the alteration of one part of the flour; 2. That not one of these products existed previously in the grain; 3. That they are formed by the complex action of a leaven which I call cerealine; 4. That, by suppressing the action of this ferment, brown bread ceases to be formed, and a white bread only is produced, superior to the ordinary kind.

Conformably with these observations, I brought into practice a process founded on the property possessed by yeast of transforming cerealine into yeast when added to a liquid in full alcoholic fermentation. This process was approved of by the Academy (Report of M. Chevreul, Jan. 12th, 1857). In England and Germany, inspired by the facts previously indicated, the end was reached in a more direct way, replacing all kinds of fermentation by introducing carbonic-acid gas, or by setting it free in the dough itself by bicarbonate of soda and chlorhydric acid. In Paris, the process approved by the Academy is not completely brought into practice: custom demanded that it should be modified so as to retain the leaven of dough, despite its drawbacks. Among the most intelligent and important advocates of the new mode, with a leaven of dough, may be reckoned the city of Paris, which furnishes the public charities and workmen of Paris with 25,000 kilogrammes per diem of bread, very superior to that of the common bakers.

I am permitted by the Academy, in the interest of the public, to give a short extract from a remarkable statement made to the Prefect of the Seine by M. Husson touching some ameliorations made during his administration from 1852 to 1869. The statement says, at page 14:—"One of the most interesting uses to which the Scipion works have been applied is that of carrying out the Mège-Mouriès process." And, further on, it continues:—"This process has been entirely adopted throughout the manufactory for four years, without alteration in the colour of the bread; and the results were highly satisfactory, although still beneath what was expected of it. The profit arising from this mode of panification is a little over 1 centime per kilogramme; besides which, the brown bread formerly consumed in the large almshouses is now replaced by white bread exactly similar to that supplied to the others by the manufactory. These results are doubtless satisfactory; but they do not at all agree with those noticed in the reports of M. Chevreul, of the Minister of War, and of General Favé, reporter for a commission of practical men chosen by the Minister of Commerce, and which included the late lamented M. Salone, formerly Manager of the Scipion Works.\*

Notwithstanding my gratitude towards the Director of Public Charities, it is as well to state the reason of these discrepancies for the sake of common manufacture, and for those co-operative societies which may feel inclined to follow the good example of Scipion.

1. The Commission has always put to profit the curious property of the embryo tissue of not allowing salted water to penetrate the interior of the grain—a property

which renders the elastic outer integuments capable of closer grinding and a larger yield.\*

2. It must not be forgotten that, before the application of the new process, hard or semi-hard wheat was used at Scipion; and, as the yield from this is much greater than that arising from young wheat, the comparative figures cannot be exact.

3. By giving the aged inhabitants of almshouses white bread instead of brown, they, in fact, receive more bread, as brown always contains more water than white. This is an advantage, and it should be reckoned.

4. The Commission, in common with the general practice, have never admitted that it was possible, by the ordinary process, to make superior bread with flour obtained above the rate of 70 per cent; and it is from this figure that the economic difference is inferred. The discrepancy is obviously only apparent. Here is the process:—

The corn is moistened with from 2 to 5 per cent of water saturated with sea-salt; and, at the end of some hours, the exterior coverings only become moist and tender. The grain is then thrown between nearly-closed millstones; and 70 per cent of flour is obtained without cerealine, plus 10 to 14 per cent of meal. This is bruised between light stones, and separated, by winnowing, from the greater part of the husk remnants.†

To prepare the bread, all the leaven is made with the flour at 70 p.c., and the meal is added to the soft dough last of all; as, in spite of the small amount of cerealine which it still contains, it will not produce brown bread, because, at that time, the length of incubation is not sufficient to change it into a leaven. Thus white bread is produced containing all the farinaceous part of the wheat (80 to 82 per cent).

Laudable efforts (pursuant of my advice) were made at Scipion to mingle the flour with the meal, which would be quite practicable could machines be obtained which would remove all fragments of outer integuments from the meal.—*Comptes Rendus*.

## LUMINOUS FOUNTAINS.‡

By Prof. H. MORTON, Ph.D.

WE believe that this experiment was first performed by Duboscq, and, though often repeated, and frequently alluded to in various publications, is generally regarded as presenting great difficulties in its re-production. Our own experience has, however, shown us that it may not only be repeated, with little cost and great ease, by anyone having the usual appliances of a gas-lantern, but that it is an illustration of great beauty and interest, which would amply repay many times the trouble of its development.

Success, however, depends upon attention to a few particulars, which, to the best of our knowledge, have never been put on record, and we will therefore proceed to give a full description of the same.

Desiring to arrange this illustration, and hearing that Mr. E. S. Ritchie, of Boston, had made very thorough and successful investigations as to its best adjustment, we wrote to him for information, and were furnished by him, in the most liberal and amiable manner, with full accounts of all essentials, by reason of which we had nothing to do but to put together a few parts as described, in order to secure at once complete success.

The important points, as described by Mr. Ritchie, and verified in our own experience, are these:—1. Avoidance of currents and commotion in the reservoir; 2. the employment of a sharpe-edged diaphragm, very smoothly finished, as a jet.

\* *Memoire de la Société Impériale et Centrale d'Agriculture*, 1860.

† At Scipion, the Perigault winnower was used.

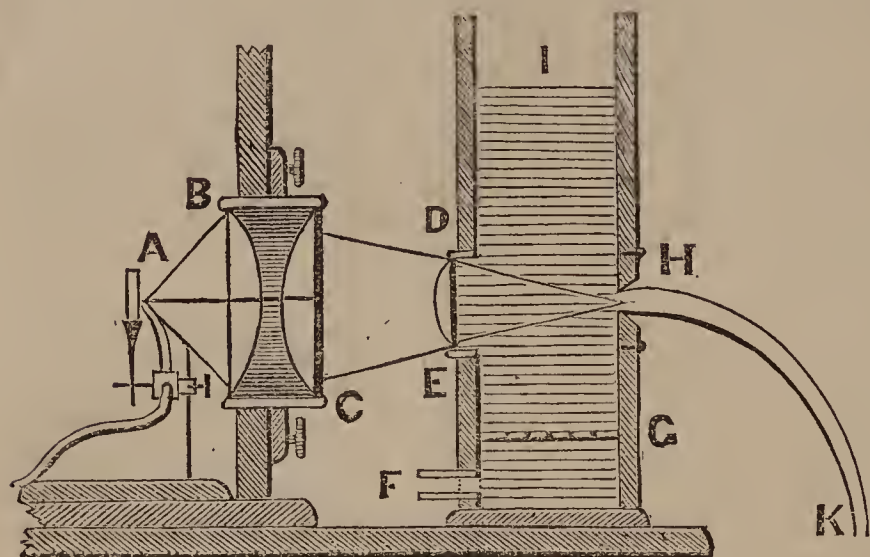
‡ Communicated by the Author.



The entire arrangement of parts is as follows:—

Let A represent the line light in the lantern-box, and B E the condensers attached to its front, the object-glass, tube, &c., being removed. By this means a cone of light is projected upon D E, which represents a plano-convex lens, of 3 to 4 inches diameter, and 6 to 7 inches focal length. This lens fits into a cell, against a ring of rubber,

FIG. 1.



upon which it is pressed by a screw-cap, so as to render the joint water-tight. The tank, P G, is made of wood or tin, about 18 inches in height, 5 or 6 inches in the direction D H, and about 1 foot transversely.

At H is attached a diaphragm, opening, or outlet, flush inside with the front of the tank, sharp-edged, and beveling outwards. Near the bottom of the tank is a perforated shelf or false bottom, E G, below which enters the inlet-pipe, F. The shelf, E G, serves to distribute the inflowing water, and prevent violent currents.

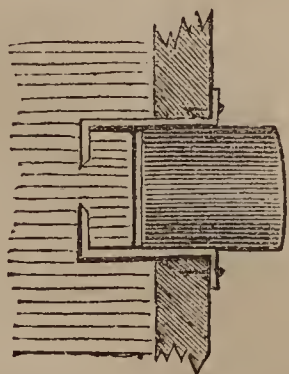
Under these circumstances, the water-supply, being carried to F by a  $\frac{3}{4}$ -inch rubber hose from a hydrant or like supply, is regulated so as to keep a steady level at I (which can be easily recognised by watching the point of contact of the jet, H K, with the basin or reservoir in which it is received), and the light is turned on in the lantern.

We then have the light from the condensers concentrated at H, and thence issuing with the vein of escaping water, from whose interior surface it is repeatedly reflected so as to follow down the entire length of the jet, which thus becomes brilliantly luminous, appearing as a stream of liquid light or luminous water.

If the jet is then received in a large glass goblet or vase, this, also, as well as the drops and streams running over and from it, will gleam and glimmer in a beautiful manner. By placing a piece of coloured glass in front of the condensers, B C, the stream of light will be converted into a jet of liquid rubies, emeralds, or sapphires, according to the colour employed.

If the supply is taken from an ordinary hydrant, the outlet, H, should not be more than 0.5 inch in diameter.

FIG. 2.



In starting and stopping, it is often desirable to close the outlet, H. To do this with a cork directly applied is at once awkward, and likely to injure the smoothness of the edge, which is so important to success. To obviate this difficulty, we have long used the following plan:—

Let the diaphragm be attached to the end of a short tube, running a little way into the tank, or projecting from it. A cork may then be used to close the outer end of this with ease, and without risk to the diaphragm.

In the experiments which we have made thus far, we have only employed jets of  $\frac{1}{2}$  inch in diameter, and making streams of 7 to 8 feet in height; but Mr. Ritchie, in some experiments made at Boston, with a view of public exhibition on the evening of July 4th, produced successfully jets of 15 to 20 feet, and  $1\frac{1}{2}$  inches in diameter, illuminating them with an electric light from 100 large Bunsen cells.

With regard to the arrangements used for this purpose, Mr. Ritchie tells me that he carried the water from the street-pipe by fire-engine hose, first to a barrel (which, being air-tight, served as an air-chamber), thence to a long, erect, conical vessel, having five horizontal partitions, pierced with numerous small holes to distribute the flow and avoid strong currents. The side of this vessel, in which the outlet was placed, was flat, and in this the sharp-edged opening was fixed. The experiment with these arrangements proved perfectly successful, and was exceedingly beautiful if the air was calm; but the least wind ruffled the jet, and spoiled the effect. Prof. Pepper, as appears in his "Play Book of Science," conducted, with great success, similar experiments in the Sydenham Crystal Palace; but, in his description, he omits to mention those points which are, as we find, essential to success.

In another form, a less theoretically, but more obviously beautiful, illuminated fountain may be arranged as follows, the description being taken from one which I arranged in one of my lectures, during the winter of 1868, at the Franklin Institute.

On a light table, about 3 feet 6 inches in height, is placed a shallow basin or pan of tin, 6 feet in diameter and about  $2\frac{1}{2}$  inches deep, supported by a skeleton framing of wood. Around the edge of this basin is placed a ring of  $\frac{3}{4}$ -inch lead pipe, provided with fifty vertical jets, each of  $\frac{1}{8}$  inch aperture, turned slightly inward. Towards the centre is a ring of similar pipe, 18 inches in diameter, also provided with fifty similar vertical jets, inclined slightly outwards. Both pipes are connected with the water-supply, but controlled by separate stop-cocks.

When operating together, they form a beautiful pyramidal sheaf of spray (in the case just mentioned) 15 feet high and 6 feet in diameter at the base. The jets are each attached by a short piece of  $\frac{1}{8}$ -inch lead tube, which allows of their ready adjustment in direction.

So much for the fountain. We next come to the arrangements for illumination.

On the lower part of the table-frame which supports the basin is arranged an ordinary magic-lantern with its condensers in its roof, protected by an inclined plate of glass, directing the ascending stream of heated gases to a crooked chimney of  $1\frac{1}{2}$ -inch tin pipe. Immediately above these condensers is an opening through the basin, with a high margin to it, on top of which fits a cap carrying a plano-convex lens of about 7-inch focus, placed with its plano side uppermost, and fitted water-tight in a cell with a deep rim. This cell being then filled with water, we get rid of the otherwise serious effect from a misplaced drop of spray on the glass: such an accident now only causes an instant's disturbance to the action of the lens, but otherwise would greatly modify its action, if lying as a bead upon it.

This lens is so adjusted, with regard to focal length and position, as to make on the ceiling, about 16 feet from the tank, a circle of light 3 feet in diameter. To the ceiling, at this place, is attached a plain mirror, which, then reflects the incident light at the same angle, so making a truncated cone, 3 feet at top and 6 feet at base, which just takes in the entire sheaf of jets.

This arrangement alone gives a very beautiful effect; but, further to increase the illustration, I had a hole cut through the ceiling, from the floor above, just outside of



the mirror, and through this directed a cone of light from a lantern with its nose turned downwards.

By using parti-coloured figures of gelatine simultaneously in the two lanterns, the effect was beautiful beyond description, a veritable fountain of various scintillating jewels being produced. By adjusting and turning on the light first, and afterwards the water, this last seemed to be the veritable source of the illumination. The light without the water-jets was scarcely appreciable to anyone not close to the tank, while the moment the fountain was turned on the whole room was lit up. The most pleasing effect of all was obtained by making glass circles with six segments of different colours, and rotating these slowly in the upper lantern, the changing prismatic tints of the various sprays being something that literally "must be seen to be appreciated."

# ON THE ABSORPTIVE POWER OF SOIL.\*

By ROBERT WARINGTON, F.C.S.

(Concluded from p. 223.)

HAVING thus described the results obtained in the College Laboratory, we will now attempt to point out those conclusions with regard to the phenomena of soil absorption which the accumulated facts of the case seem to warrant.

The question which chiefly demands attention is the nature of soil absorption. Is it a physical or chemical action, and by what ingredients of the soil is it exerted? In order to form a definite notion concerning the first part of this question, let us, in the first place, inquire, What is physical attraction? We will take the decolourising power of charcoal as an example of this action.

Liebig tells us, and we believe rightly, that the attraction of the charcoal for the particles of colour is quite similar to the attraction by which these particles were previously dissolved and held in solution by water. "If the attraction of the charcoal is somewhat greater than that of the water, then the colouring-matter is completely withdrawn from the water; if the attraction of both is equal, a division takes place, and the extraction is only partial."† Liebig, however, characterises this power of charcoal as *chemical*:—"This power in charcoal depends upon a chemical attraction proceeding from its surface"‡. Other chemists affirm, on the contrary, that the attraction of both charcoal and water is simply a case of physical adhesion; the same action by which a stick dipped in water comes out wetted. Against the chemical hypothesis it may be urged with force, that, to use Liebig's own words, "the materials attracted by the charcoal retain all their chemical properties;" so that on this view we really have chemical action taking place without any chemical change resulting. In support of the second hypothesis it may be observed, that charcoal appears to attract chiefly those substances which are sparingly soluble in water; those, in fact, for which water has a small adhesive power, that may with comparative ease be overcome.||

Assuming, then, as most probable, that the action of charcoal and other similar absorbents is owing to the physical attraction of adhesion, we have next to ask, Is this physical attraction exerted by soil, and can the absorptive properties of soil be thus explained?

It seems very probable that physical attraction is exercised by soil, and that the clarifying action of clay,

and of soils generally, when brought in contact with sewage and similar solutions, is mainly owing to an absorbent action very similar to that exerted by charcoal under the same circumstances. But this physical action of soil we believe to have little or nothing to do with the absorption of ammonia, potash, phosphoric acid, and generally of those salts which form an important part of plant-food. Charcoal appears to be quite incapable of removing ammonia from solution, and it seems, indeed, unlikely that so soluble a substance should be removed from solution by the force of adhesion of any solid body. The same may be said of many other soluble salts readily taken up by soil, but unaffected by charcoal. The probability of the action of soil in these cases being due to physical attraction is therefore very small. On the other hand, we have considerable evidence of chemical action in the absorption of many substances by soil; the evidence is, perhaps, strongest in the case of phosphoric acid.

It is now allowed by most agricultural chemists that the hydrated ferric oxide and alumina of soil unite with the phosphoric acid applied in manure, and form basic phosphates of iron and aluminium. We have already described some experiments which appear satisfactorily to establish this reaction between soil and phosphoric acid. E. Peters has also recently published a research upon the same subject.\* He endeavoured to ascertain the state in which phosphoric acid was held in soil, by acting on a soil, recently manured with bone dust, with different solvents. He came to the conclusion, "that the phosphoric acid in soils is almost entirely combined with ferric oxide and alumina;" and "that from a solution of phosphate of calcium in carbonic acid, phosphoric acid is taken up by soils only when the latter contain compounds of alumina or ferric oxide; soils deprived of these compounds by treatment with acids are indifferent to the phosphatic solution." His conclusions thus perfectly agree with those stated above; the absorption of phosphoric acid by soil is considered to be a purely chemical operation.†

If we turn to the phenomena which attend the absorption of bases from their salts, we also find considerable evidence of chemical action. The facts we refer to have been already noticed. We have seen that soil acts differently towards various salts of the same base; that the bases of phosphates and carbonates are taken up by soil in greater quantity than the bases of sulphates, chlorides, or nitrates. This preference is certainly due to the chemical relations of the various acids to the constituents of soil. The reaction between a soil and an alkaline phosphate will, after the previous discussion, be quite plain to us; the acid of the salt will be appropriated by the ferric oxide or alumina, and the base be thus left in the form of hydrate, the form most favourable to combination. Carbonates are known to all chemists as salts that are easily decomposed, even by bodies of feeble acid properties; the ready absorption of bases from their carbonates might therefore naturally be expected. The carbonic acid liberated probably combines, in most cases, with the lime of the soil. In one of Way's experiments, in which a solution of carbonate of ammonium had been poured upon soil, bicarbonate of calcium was found in the water which drained through. Sulphates, chlorides, and nitrates are not taken up by soil to any appreciable extent unless the soil already contains lime, magnesia, or soda; or, to speak more accurately, some base for which the absorbing ingredients have a smaller affinity than they have for the base of the salt presented to them. In the majority of cases lime is the active base in these reactions, and the acids of the salts are found combined with lime in the drainage water from the soil. Way showed in the case of a chloride, and Voelcker in the case

\* *Practice with Science*, vol. ii.

† "The Natural Laws of Husbandry," p. 66.

‡ *Ibid.* p. 65.

§ For some excellent observations on the subject, see Miller's "Chemistry," vol. i., pp. 73-75.

\* *Annalen der Landwirthschaft*, 1867, p. 31.

† When a solution of superphosphate is applied to soil, the phosphoric acid is probably in the first instance precipitated by the lime of the soil; the action of the ferric oxide is in this case subsequent and gradual.



of a chloride and nitrate, that none of the acid of the salt was absorbed by the soil. The salts had been decomposed by the lime of the soil, and their bases only had been removed from solution.\*

Facts, in short, show very clearly, that when the solution of a salt is brought in contact with soil, the salt is always decomposed if absorption takes place; this decomposition is, of course, clear evidence of chemical action. We have been able to give a tolerably satisfactory account of all these reactions as far as the acids of these salts are concerned. We are not able to account so certainly for the bases; they are absorbed by the soil: but with which of the ingredients of the soil do they combine? We cannot trace their course in the reaction, and are obliged to resort to secondary evidence.

We have already mentioned two classes of bodies which experiment has shown capable of removing bases from the solutions of their salts; these are the hydrated double silicates, and the hydrated oxides of iron and aluminium. Now, if these compounds can be proved to exist in soil we are certainly warranted in including that the absorption of bases by soil is due to a greater or less extent to their influence.

There is no doubt whatever as to the occurrence of hydrated ferric oxide in soils; it is probably a universal ingredient of soil, and is often present in very considerable amount. The occurrence of hydrated alumina in soils is doubted by some chemists; it is, in fact, difficult to tell to what extent the alumina found in soil is combined with silica, and to what extent it exists merely as hydrate. The question does not, however, materially affect our argument, as we have seen that ferric oxide is apparently a far more efficient absorbent of bases than alumina. We may consider it, therefore, as established, that the ferric oxide present in soils plays a part in the absorbent action of soil towards bases, and that the bases absorbed by soil become, in part at least, united to ferric oxide.

It is very difficult to prove the presence in soils of the particular class of double silicates which Way has shown to possess such a remarkable power of removing potash, ammonia, and other bases from solution.† That soils contain both silicates, and hydrated silicates, does not admit of doubt; in fact, silicates are often the largest constituents of soil; but that the hydrated silicates are silicates of aluminium and calcium, is more than chemical analysis has yet been able to decide. The probability that such silicates are present is, however, very great. The feldspars and micas, from the disintegration of which the silicates of soil are chiefly formed, are all of them double silicates of aluminium with potassium or some other alkaline or alkaline-earthly base; that in the decomposition of these hydrated double silicates of a similar constitution should be formed, is certainly to be expected. There appears, in fact, no ground for reasonable doubt that the silicates described by Way are really present in soils, and we must, consequently, ascribe to these silicates a part in the absorbent action of soil.

There yet remains another ingredient of soil which, probably, takes some part in the absorption of bases,—this is the humus. Humus, or rather the various bodies which compose it, possesses a feeble acid character, and being insoluble in water, or nearly so, is very probably capable of forming insoluble compounds with bases. Brustlein‡ has experimented with pure humus obtained

\* We should expect from the results obtained when sulphate of ammonium was placed in contact with hydrated alumina and ferric oxide, that under some circumstances sulphuric acid would be retained in the soil to an appreciable extent. Curiously enough, this fact was noticed by Mr. H. S. Thomson in his original experiments of 1845. I have found no reference to it since. He observed that a solution of sulphate of ammonium became *alkaline* on being filtered through soil. The reaction would probably be observed in the case of soils rich in the hydrated oxides, but poor in lime.

† Eichhorn has examined the properties of chabazite, a native hydrated silicate of aluminium and calcium; he found that, placed in contact with a solution of chloride of ammonium, it absorbed a large quantity of ammonia and parted with lime, and in other respects comporting itself like Way's artificially prepared silicate.

‡ *Jahresbericht der Agrikultur-Chemie*, 1859-60, p. 1.

from a decaying oak. He found it to possess a considerable power of absorbing free ammonia, but with solutions of the salts of ammonium it failed to effect any absorption. Since soils and clays almost destitute of organic matter often possess high absorbent powers, the part taken by humus is probably of inferior importance.

We have, then, evidence that soil contains several ingredients that have the property of forming more or less insoluble compounds with bases, and are known to be capable of withdrawing bases from solution. Though, therefore, we are unable to trace the mode of combination of the bases absorbed by soil, we conclude, upon the evidence thus before us, that they are combined either with hydrated metallic oxides, with hydrated double silicates, or possibly with humus.

Our conclusions respecting the cause and manner of soil absorption may be summarised as follows:—

1. It appears that the hydrated ferric oxide and alumina of soil have a notable power of absorbing phosphoric acid from the solutions of its salts, and, to a much smaller extent, a capacity for taking up sulphuric, hydrochloric, and nitric acid (at least if these acids are presented in the form of ammonium salts) and that in all these cases the product of the absorption is a highly basic compound of the acid with the metallic oxide. It appears, further, that these metallic hydrates are also capable of absorbing bases, with which they either combine directly, or form highly basic double salts with acids either previously or at the same time absorbed. The hydrates are, however, incapable when alone of affecting any considerable absorption from a chloride or nitrate, although in the soil they probably absorb bases from these salts without difficulty, owing to the decomposing action of the lime of soils.

2. The hydrated double silicates contained in soil also exercise a very considerable absorptive power, which is confined to bases. The hydrated silicate of aluminium and calcium is capable of absorbing potash or ammonia from all the salts of these bases, and probably with nearly equal energy from each. The product in each case is a new hydrated double silicate, in which the calcium is more or less perfectly replaced by potassium or ammonium (the calcium thus displaced combining with the acid of the potassium or ammonium salt).

3. The humus contained in soil appears also to be capable of forming, to some extent, insoluble compounds with bases.

4. Some of the calcium salts contained in soil, probably the carbonate, the silicate, and compounds of lime with ferric oxide and alumina, assist in several ways the operation of soil-absorption. By combining with the acids of certain salts, as carbonates, sulphates, chlorides, nitrates, they allow the bases of these salts to unite with the hydrated metallic oxides. The carbonate of calcium also converts the soluble acid phosphates applied in manure into sparingly soluble calcic phosphates, which, as they gradually enter into solution, are converted into ferric and aluminic phosphates, as already described.

5. Lastly, besides these chemical actions of the ingredients of soil, several of the component parts of soil possess the power of attracting to their surface certain organic and sparingly soluble compounds, by virtue of simple physical adhesion. This power is apparently possessed by clay, by the hydrated metallic oxides, and possibly by humus. To the existence of this power the decolourising and clarifying properties of soil are due.

The absorptive power of soil does not therefore reside in a single ingredient, nor is it to be attributed to a single action. Soils of very various character and composition may equally enjoy this important property. With clay soils the silicates and alumina will chiefly sustain the action; with loams and sandy soils the ferric oxide will play an important part; with pasture soil the action of the humus rises in significance. It is not to be supposed, however, that absorption in all these cases amounts to the same thing. The compound of a base with a silicate, with a metallic hydrate, and with humus, must, in every



case, possess distinct properties, will probably resist in a different degree the solvent action of water, and be variously affected by other chemical agents. The difference to the plant between these different compounds may, possibly, be considerable. The relation of both the quantity and kind of the absorptive power of a soil to its fertility, and the influence of cultivation upon both aspects of this property of soil, is, I believe, a subject yet untouched, and can, perhaps, hardly yet be attempted until more perfect investigations have been made upon the elementary parts of this great question. These, we need scarcely say, are grievously needed. When will the country that owes so much to agriculture, and depends so greatly upon its successful pursuit for prosperity, perceive the importance of directly furthering such objects? Germany has its forty-five experimental stations, supported by the respective Governments, these establishments being devoted to the scientific study of agricultural questions. England, to the honour of individual effort, possesses one station (that at Rothamsted) which all admire, but none have imitated. The labours of our voluntary workers have contributed many valuable miscellaneous researches. The agricultural societies of this country, and the college at Cirencester, have also done good work: but for the task before them these institutions are, both singly and collectively, inadequate. Until, in fact, the prosecution of agricultural science is acknowledged to be an object worthy of national exertion, the thorough investigations which the subject demands can hardly be expected.

## DETERMINATION OF IRON WITH DICHLORIDE OF COPPER.

By Dr. WINKLER.

DURING the last few years, much labour has been spent in order to find a method of determining iron volumetrically, based on the conversion of sesquioxide to protoxide.

The reducing agents that have been in use up to this time are protochloride of tin and iodide of potassium; but the dichloride of copper is now found to be a much more powerful reducing agent for sesquioxide of iron, though analogous to protochloride of tin in its effects. While protochloride of tin causes but a partial reduction in a cold solution, dichloride of copper acts directly with theoretical accuracy at the lowest temperature, and in any dilution. It is, therefore, particularly adapted for the volumetric determination of iron.

The completion of the reduction may be ascertained with certainty by the addition of a few drops of sulphocyanide of potassium to the solution to be tested, when the well-known deep-red colour appears. When the dichloride solution is dropped into one of iron so coloured, the red colour becomes lighter and lighter, and finally disappears entirely. After the solution is bleached, the reduction of the iron is complete, and the next drop of copper solution causes a precipitate of the disulphocyanide of copper. This gives a double indicator of the end of the reduction, namely, the blacking of the red colour of the sulphocyanide of iron, and the cloudiness produced by the insoluble salt of copper.

The rapidity and simplicity of the process, as well as the few accessories required, recommend this method, especially to technical laboratories, where the want of a short and accurate process has ever been felt. For carrying out the above-mentioned determination, there is needed:—

1. *A solution of dichloride of copper.* This is made by dissolving sheet-copper in nitric acid; then evaporate, to drive off the excess of nitric acid; and the residue is taken up in water containing hydrochloric acid. This

solution is put into a flask, and a quantity of common salt (NaCl) equal in weight to the residue of dry copper-salts is added, in order to prevent the separation of a precipitate of dichloride of copper during the subsequent reduction. Several pieces of sheet-copper are put in the flask, and it is then heated to boiling. This is continued until the solution is nearly colourless, and all the chloride of copper has been changed to dichloride. The flask is then corked, and allowed to cool; then the solution is diluted with water containing hydrochloric acid until 1 cubic centimetre corresponds to 6 milligrammes of iron. In order to keep this solution without change for further use, it should be poured into a bottle, to which is fitted an air-tight stopper, and a spiral of thick copper wire reaching from the bottom to nearly the neck. This completely protects the dichloride of copper from a higher oxidation, so that the strength of the solution remains nearly always the same. In all cases it is best and most accurate to determine the strength of the standard from time to time, since this requires but a few minutes; therefore, for this purpose, there is needed—

2. *A solution of sesquichloride of iron* of known strength. This may be made, according to Fresenius, by dissolving in hydrochloric acid and chlorate of potash 10.03 grms. of piano-wire, corresponding to 10.000 grms. of pure iron, and diluting to 1 litre. For each test of the standard, 10 c.c. of this solution is taken, which contains 100 milligrammes of iron.

In noting the end of the reduction, though it is not necessary that the solution of sulphocyanide of potassium should contain a known amount of this salt, yet it will be found better to use about the same strength at all times, since the presence of too much sulphocyanide makes the reaction less marked.

In performing this volumetric determination of iron, there are but few rules to be observed. It is advisable that the solution to be treated be quite acid and very dilute before it is brought under the burette. A solution that contains 100 to 200 milligrammes of iron should be diluted to 500 c.c. or more.

In adding the sulphocyanide, care must also be taken; for, if too much is added to the iron solution, although a deeper blood-red will be obtained, yet a difficultly-soluble sulphocyanide of copper may separate, clouding the solution and re-dissolving with trouble. Four or five drops of the above-mentioned solution are quite sufficient to be added. Then, by dropping in the copper solution, the bleaching takes place with extraordinary sharpness, and only when all the iron has become a protoxide does the next drop cause a permanent cloudiness.

The presence of coloured metallic compounds (as salts of cobalt, nickel, and copper) does not in the least hinder the recognition of the reactions, if the solution is properly dilute. Neither does the presence of arsenic acid affect the process, since this is not reduced by dichloride of copper. This process, therefore, is important to the metallurgist, who is often compelled to determine quickly and correctly the amount of iron contained in a matt, or speiss, or other product. By the above process, this is possible in an hour.—*Journ. für Prakt. Chem.*, vol. xcv., No. 15.

## ON AMMONIA-CHROMIUM BASES.

CLEVE has communicated to the Royal Swedish Academy of Sciences a memoir on the ammonia-chromium bases. The author sets out with the chloride discovered by Fremy, and investigated to some extent by himself in a previous memoir. To this he gives the formula—



and the name tetramin chrom-chloride. It will be sufficient for our purpose to give the formulæ of the various compounds, with a general account of their properties.



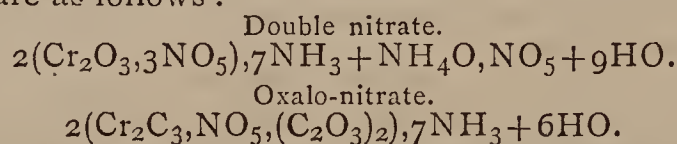
The formulæ of the salts described by Clève belonging to the tetramin series are as follows:—

Chloride,	$\text{Cr}_2\text{Cl}_{3,4}\text{NH}_3, 2\text{HO}.$
Chlorplatinate,	$\text{Cr}_2\text{Cl}_{3,4}\text{NH}_3, 2\text{HO} + 2\text{PtCl}_2.$
Chlorhydrargyrate,	$\text{Cr}_2\text{Cl}_{3,4}\text{NH}_3, 2\text{HO} + 6\text{HgCl}.$
Chlorobromide,	$\text{Cr}_2\text{ClBr}_{2,4}\text{NH}_3, 2\text{HO}.$
Bromide,	$\text{Cr}_2\text{Br}_{3,4}\text{NH}_3, 2\text{HO}.$
Bromochloride,	$\text{Cr}_2\text{BrCl}_{2,4}\text{NH}_3, 2\text{HO}.$
Chloro-iodide,	$\text{Cr}_2\text{ClI}_{2,4}\text{NH}_3, 2\text{HO}.$
Iodide,	$\text{Cr}_2\text{I}_{3,4}\text{NH}_3, 2\text{HO}.$
Chlorosulphate,	$\text{Cr}_2\text{ClO}_{2,4}\text{NH}_3, 2\text{SO}_3, 2\text{HO}.$
Bromosulphate,	$\text{Cr}_2\text{BrO}_{2,4}\text{NH}_3, 2\text{SO}_3, 2\text{HO}.$
Chlorochromate,	$\text{Cr}_2\text{ClO}_{2,4}\text{NH}_3, 2\text{CrO}_3, x\text{HO}.$
Chloronitrate,	$\text{Cr}_2\text{ClO}_{2,4}\text{NH}_3, 2\text{NO}_5, 2\text{HO}.$

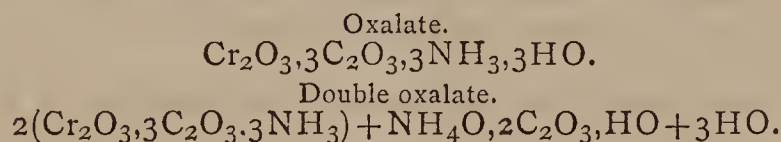
All these salts are crystalline and easily soluble in water; they have a carmine-red or garnet-red colour, and their solutions are easily decomposed on heating, with separation of chromic oxide and evolution of ammonia. The author calls attention to the very noteworthy fact that they all contain 2 atoms of water (in the old notation).

The second series of compounds described are the salts of heptamin-dichromium.

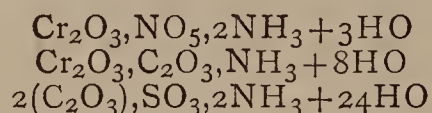
The formulæ of the only observed members of this series are as follows:—



The salts of the triamin series are as follows:—

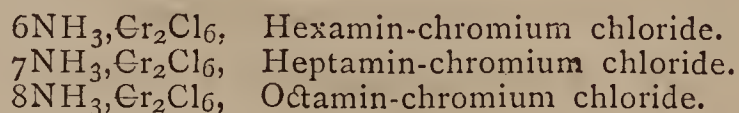


The salts of the heptamin and triamin series resemble those of the tetramin series so closely as not to require special description. The nitrate of the heptamin series is obtained by the action of nitrate of silver upon the chloride of tetramin-chromium. The oxalate of the triamin series is obtained by the action of oxalic acid upon the same chloride. Besides these three series, the author describes the following salts, which may obviously be regarded as members of other and analogous groups:—

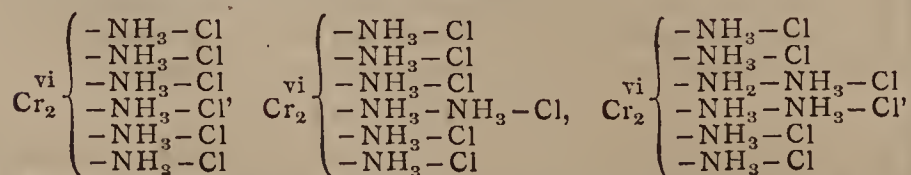


It is, however, very doubtful whether these three substances were obtained in a state of purity, as they were all amorphous, and could not be obtained crystallised.—*Kongliga Svenska Vetenskaps-Akademiens Handlingar, Ny Följd*, vol. vii., 2nd half.

[Note, by Dr. WOLCOTT GIBBS.—The compounds described by Clève are of especial interest when considered from an atomistic point of view. The formulæ of the triamin and tetramin series are, of course, to be doubled; and we should then have, for the three chlorides, the empirical formulæ—



Adopting Blomstrand's view of the constitution of the analogous platinum and cobalt compounds, these three bodies may be written as follows:—



Cleve suggests that the heptamin series may be only double salts of his tetramin and triamin compounds; and,

in view of the unsymmetrical structure of the chloride, this seems at least probable. It is also to be borne in mind that the want of symmetry is only seen if we adopt Blomstrand's theoretical views, and does not appear when the ammonia bases are formulated according to the principles of variable atomicity supported by the writer.\* The invariable occurrence of 2 atoms of water in all the octamin compounds is difficult to explain upon any theory.—*American Journal of Science*, vol. xlix., p. 251.

## USE OF A BELL-JAR AND BEAKER WITH BUNSEN'S PUMP.

By ALBERT R. LEEDS.

THE following attachment to Bunsen's pump (see *CHEMICAL NEWS*, vol. xix., p. 161), which suggested itself some time ago has now been in use for several months, and its merits are such as to deserve more particularly the attention of chemists. Instead of the cumbrous



bottle generally employed, the plate of an air-pump may be advantageously substituted, and a receiver, with an india-rubber cork, through which the neck of the funnel is passed, as represented in the drawing. In order to prevent loss by the bursting of bubbles of air at the end of the tube of the funnel, it is continued low down into the beaker by an india-rubber tube, A. The latter can easily be removed at the end of a filtration, and the drops of adhering

liquid, washed with water from the spritz, into the filtrate. This simple arrangement obviates the necessity of a transfer from one vessel to another, and permits all the operations of an analysis to be carried on as usual, in beakers. Instead of an air-pump plate, a sheet of glass may be used, and the exhausting tube as well as the funnel in this case must be passed through the tubulure of the bell-jar. A similar arrangement is useful for the desiccation of bodies, either alone or with sulphuric acid.—*Journal of the Franklin Institute*.

## IMPROVED FORM OF WASH-BOTTLE.

By ALBERT R. LEEDS.

THE accompanying drawing represents a wash-bottle which I have seen in use abroad, but which I have not seen in text-books or employed at home. The delivery tube, A,



is bent sharply upon itself, and then cut off at a point not quite directly above where it makes the first bend. The jet is bent in the same manner but in a contrary direction, and the two parts are connected by an india-rubber tube. Over this is fitted a short piece of glass tube, of such a bore as to fit tightly, yet permit, at the same time, the jet to be pointed upward, downward, or in any direction. In transferring precipitates from one beaker to another, or in washing a precipitate back into a beaker, &c., such a form of wash-

bottle is much more convenient than that in common use. B is the entrance tube; C, cork tied around the neck of the bottle; D D D, pieces of india-rubber tubing where the glass tubes, in order to give greater flexibility, are cut into parts. The delivery tube is bent at E so as to reach into that corner which is lowermost when the flask is inclined.—*Journal of the Franklin Institute*.

\* *American Journal of Science*, vol. xlix., p. 108.



## CORRESPONDENCE.

### ESTIMATION OF CHLORINE IN NATURAL WATERS.

To the Editor of the Chemical News.

SIR,—Mr. Blunt has given, in the last number of the CHEMICAL NEWS, a method of determining chlorine volumetrically in natural waters. He seems to be unaware that this process has been published many years (see Fresenius's "Quantitative Analysis," p. 310, 4th. edit., 1865). The credit of first using potassic chromate as an indicator is due, I believe, to Mohr. To my personal knowledge it has been in use daily for the last three years at the Royal College of Chemistry, and where I do not think they would be satisfied with the results first cited, viz:—

Volumetrical  
estimation.  
0.994

Gravimetical  
estimation.  
0.8904

or a difference of 0.1.—I am, &c.,

SCRUTATOR.

### TETRABROMIDE OF CARBON.

To the Editor of the Chemical News.

SIR,—My attention having been called to a report of our paper on  $\text{CBr}_4$  (carbon tetrabromide), in a recent number of the CHEMICAL NEWS, I must ask you to correct an error of some importance. So far from our proposing the action of *terbromide of antimony* on carbon disulphide as a means of preparing tetrabromide of carbon, I am not aware that these two substances have any action upon one another at the temperature specified ( $150^\circ \text{C.}$ )—I am, &c.,

CHARLES EDWARD GROVES.

17, Rodney Street, Pentonville.

[Our report was official.—*Ed. C.N.*].

## MISCELLANEOUS.

**New Locality and Commercial Source of the Oxides of Nickel and Cobalt.**—In a letter to the editor of the *Journal of the Franklin Institute*, Mr. C. P. Williams says that—"Of the auriferous deposits of Nueva Providencia, Venezuela, thus far opened and worked, the vein known as 'La Corina' has been most thoroughly exploited. Operations on it have extended already to the depth of upwards of 70 feet, and have developed a vein of about 4 feet average thickness, with a general N. E.—S. W. course, and standing at a high angle. The wall rocks are, even to this depth, completely decomposed and converted into clayey masses of various colours (locally used for pigments), but are separated from the compact hard white quartz of the vein by heavy and well-marked selvages or seams, of a soft black manganiferous substance, resembling, in appearance and physical properties, the variety of wad known as *asbolite*, but differing from that mineral in giving no reactions of water of combination (after being freed from its hygroscopic water by drying at  $100^\circ \text{C.}$ ), and in showing a very considerable percentage of oxide of nickel. The substance forms, not only the selvages or flucans of the veins, but also the gossan, and fills the seams of the disturbed and shattered portions of the lode, appearing as a cementing material, as it were, of the fractured quartz, and giving to the vein a brecciated structure. Assay shows it to be quite rich in gold, containing the metal in workable amounts. With hydrochloric acid it is completely decomposed, liberating chlorine with the separation of gelatinous silica. The following is an analysis of the sub-

stance (dried at  $100^\circ \text{C.}$ ) made by Mr. Roberts Le Boutilier, a pupil in my laboratory:—

	Per cent.
Protoxide of manganese .. .. .	46.973
Oxygen, in combination with above	7.545
Sesquioxide of iron .. .. .	4.073
Alumina .. .. .	15.934
Oxide of copper .. .. .	0.528
Oxide of cobalt .. .. .	3.555
Oxide of nickel .. .. .	10.385
Oxide of zinc .. .. .	traces
Lime .. .. .	1.605
Magnesia .. .. .	1.653
Silicic acid .. .. .	8.653
	100.264

The oxides of nickel and cobalt were separated by means of the nitrite of potassa method. The available oxygen was determined in the usual method for the valuation of manganese ores—that is, by means of its conversion into carbonic acid in the presence of oxalate of potassa and sulphuric acid. This mineral is not confined to La Corina, but is so abundantly distributed throughout the gold region of Venezuela, that it may ultimately become an important source of raw material for the preparation of nickel and oxide of cobalt; and with this in view, the writer makes the notice of its occurrence public. A. B. Garner, Esq.; to whom I am indebted for the specimens for analysis, as well as for most of the facts with regard to the manner in which they occur, assures me the substance is the common accompaniment and gossan of other auriferous veins of the region."

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, with their copious indices, will, therefore, be equivalent to an English edition of the "*Jahresberichte*."

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

*Comptes Rendus des Séances de l'Académie des Sciences*, May 1870.

This number, an unusually small one, in consequence of the pre-occupation of the French concerning the Plebiscite, contains the following original papers and memoirs relating to chemistry and collateral sciences:—

**Substances Isomeric with Cyanuric Ethers.**—Dr. A. W. Hofmann and O. Olshausen.—This lengthy paper is substantially the same as that quoted by us from the *Berichte der Deutschen Chemischen Gesellschaft zu Berlin*, No. 6 (CHEMICAL NEWS, vol. xxi., p. 227).

**Geological and Mineralogical Description of the Spanish Provinces of Murcia and Albacete.**—F. de Botella.—The celebrated geologist, M. Elie de Beaumont, while presenting to the Academy the work of this author, published under the above-named title by order of the Spanish government, speaks in very highly eulogising terms on the great merits of this work, especially, also, for the great value of the work for the practical miner.

**The Sun's Spots.**—L. Sonrel.—The author presents to the meeting a series of photograms, taken daily since the 12th ult., representing accurately the changes the spots have undergone during the month.

**Respighi's Theory of Scintillation.**—H. Tarry.

**Differences which the Value of one and the same Musical Interval Possesses, according to its being methodically heard—that is to say, with successive or Harmonious Sounds.**—G. Guérout.

**Molecular Action Studied as being founded on the Theory of Capillary Action.**—C. A. Valson.

**On Sand and Blood Rains.**—H. Tarry.—After referring to the erroneous and superstitious opinions held on this subject in former ages, the author explains, at length, his sound reasons for averring that, as far, at least, as the southern parts of Europe are concerned



these phenomena are due to dust and finely-divided sand carried over from Africa across the Mediterranean by cyclones, the course and origin of which is fully explained; but the author admits that the ashes and lapilli of volcanoes have often been carried through the atmosphere for enormously-great distances, and thus contributed to constitute what was termed rain of ash, or dust, or even blood, according to the colour of the materials, sometimes accompanied by real rain.

**Method Employed by M. Jamin for the Determination of Specific Heat.**—Dr. Pfaundler.—This paper is solely written with the view to prove and unequivocally establish the author's priority in reference to the use of the method alluded to.

**Preparation of Bromide of Sodium on the Large Scale.**—M. Castelhaaz.—The author, a manufacturing chemist, states, in the first place, that, according to the communications received by him from several physicians who have applied bromide of sodium in their practice, instead of bromide of potassium, the efficacy of the former is far greater than that of the latter. As regards the preparation of this salt, the author says—The best plan is to prepare, first, bromide of ammonium, by causing bromine to fall drop by drop into dilute, but pure, liquid ammonia contained in a series of Wolff's bottles, in order thus to prevent the loss otherwise inevitably resulting from the volatilisation of the products formed by the great heat disengaged on the bromine and ammonia uniting. The liquids, after saturation, are evaporated in a cast-iron retort, to which an earthenware receiver is fastened, wherein are collected the vapours of water, any excess of ammonia, and some bromide of ammonium, which is accidentally carried over. The bromide of ammonium thus obtained is converted into bromide of sodium, by being mixed with pure carbonate of soda, and the application of sufficient heat to volatilise and sublime the carbonate of ammonia formed by the reaction. This mode of preparation yields, after re-solution of the bromide in water, and evaporation similar to that used for chloride of sodium, perfectly pure and anhydrous bromide of sodium.

*Cosmos*, May 7, 1870.

**Utilisation of Sewage-Water for Irrigating Purposes.**—M. Lecouteux.—The author gives an account of the experimental trials arranged at some short distance from Paris, where a daily quantity of no less than 6000 cubic metres (equal to rather more than 210,000 cubic feet, or 6000 tons' weight) of sewage-water is run over a surface of 6 hectares, of what used to be an unfertile soil, which, by this means, has been converted into productive market-garden ground. The author speaks highly of the success obtained in every respect, especially also as regards the very efficient retention by the soil of all suspended materials of the water.

**New Arrangement for the Bichromate Battery.**—Dr. Chuteaux.—In order to obviate the want of constancy and the strong polarisation of the bichromate battery, due to the deposition of chromium alum on the zinc, the author adds bisulphate of mercury, and, by a peculiar arrangement, causes the liquid to be renewed by circulation.

**Ancient Glaciers of the Central Plateau of France.**—E. Colomb.—A first instalment of a very interesting geological paper. By central plateau, is meant that portion of France which is the most elevated above the sea level. The size of this plateau is 300 kilometres from north to south, and about the same from east to west.

**Preserved Meat.**—Dr. Stein.—The author, while lecturing last Saturday week, at Dresden, on the preservation of food, produced a tin canister, of good size, containing butcher's meat preserved by Appert's method, and prepared by himself in 1851. On opening the canister, which was filled nineteen years previously, the meat was found to be as fresh and full of flavour as when it was first placed in the canister.

*Zeitschrift für Chemie von Beilstein*, No. 7, 1870.

This number opens with the programme for the prize essay of the Beneke Stiftung, at Göttingen. This document, leaving out of the question the rather lengthy introduction to the real subject proposed, is the following:—A new and very exact determination of the atomic weights of the earthy metals (Erdmetalle); also the precise determination of the limits of error of the experiments made; and, moreover, a critical review of the labours of various authors made in this direction. The proposers also require elucidation of the question, whether the hypotheses of Prout and Dumas are to be retained or rejected; and it is also desired that the author should investigate the point in how far the differences existing between these hypotheses may be explained on physical or chemical grounds. Answers may be sent, written in German, Latin, French, or English languages, on or before the 31st of August, 1872, to Dr. W. Müller, at Göttingen; and the distribution of the prizes (the first being of the value of £75, and the second of the value of £30) takes place at Göttingen, on the 11th of March, 1873. Each essay should bear a motto, and be accompanied by a sealed billet, bearing outside the same motto, and inside the author's name and address—the essays, &c., to be sent carriage or postage paid.

The number contains the following original papers:—

**Electrolytic Experiments.**—P. Burckhard.—After describing, at some length, the arrangements made for these experiments, the author states—Oxide of bismuth,  $\text{Bi}_2\text{O}_3$ , is not a conductor of electricity unless it be in state of fusion, but in that case one of the copper electrodes becomes coated with bismuth; while, if platinum electrodes are used, there is formed at one of the electrodes a very fusible alloy of the two metals. Fused borax is not a bad conductor, although the author confirmed the statement, made by Dr. Tichanowitsch, that pure

boric acid does not conduct electricity at all. When borax in fused state is experimented with, a series of compounds are formed or volatilised; but the main result is its decomposition into soda, oxygen, and boron. Pyrophosphate of soda in fused state yields, among the products of electrolysis, phosphide of platinum, if a platinum electrode be applied; but the decomposition, which is chiefly the result of the electrolysis of this salt, is its splitting up into oxygen, phosphorus, and soda. Carbonate of soda in fused state is a good conductor of electricity; it is decomposed into carbonic acid and soda, but a small portion of carbon is also formed.

*Moniteur Scientifique*, No. 321, May 1, 1870.

This number contains the following original papers relating to chemistry or collateral sciences:—

**Preparation of Liquid Iron Soap.**—Dr. Hildwin.—Under this name there is used, as liniment against burns, a substance which the author states to be oleate of iron, prepared by heating, on a water-bath, oleic acid, and adding thereto, gradually, freshly-precipitated peroxide of iron, which, while the mixture is continually stirred, is readily dissolved. Oleates of other metallic oxides may be prepared in the same way.

**First Importation of Cinchona Bark from Java.**—It appears that, towards the end of last year, a quantity of some 930 lbs. of this bark has been exported from Java to the Netherlands. According to analysis made by Dr. B. Moens, in Java, this bark contains from 2.4 to 7.5 per cent of alkaloids, of which quantity 0.59 to 3.67 is quinine. The loss of weight occasioned by the drying of the bark has been found to amount to 66 per cent. There is every prospect that within some six or seven years hence Java will largely export this drug; and the cultivation of the cinchona trees is also to be extended to Sumatra, Celebes, and the Moluccas.

*Annalen der Physik und Chemie, von Poggendorff*, No. 3, 1870.

This number contains the following original memoirs and papers:—

**Course of Electric Currents through Gases of Various Density (Sp. Gr.), and between Poles of Different Shapes.**—E. Edlund.

**Composition of Tourmalines.** (Second paper.)—C. Rammelsberg.—This memoir is divided into the following sections:—Behaviour of tourmalines at red heat; the boron of tourmalines; quantity of fluorine contained in tourmalines; degree of oxidation of iron in tourmalines; description of various tourmalines—viz., brown tourmaline from New York, brown from Windischkappel, tourmaline from Eibenstock, black tourmalin from Zillerthal, tourmaline from Orford, black tourmaline from Texas (Lancaster Co., Penn.), and several more. This paper is to be continued.

**Theory of Colours.**—Dr. J. J. Müller.

**Emission, Absorption, and Reflection of the Kinds of Heat Radiated at Low Temperatures.**—Dr. G. Magnus.—This lengthy memoir is divided as follows:—Emission and absorption; description of the experiments; absorption of heat through diathermic bodies; theoretical considerations; radiation of rock-salt; on the heat passing through plates of clear rock-salt of a thickness of from 2.5 to 3 m.m. at 150°; thicker plates of rock-salt; radiation of sylvine; on the heat passing through clear plates of sylvine of from 2.5 to 3 m.m. thickness at 150°; radiation of fluor spar; on the heat which passes through perfectly transparent plates of fluor spar of about 3.8 m.m. thickness at 150°; radiation of chloride and bromide of silver; on transparency.

**Width of the Spectral Lines.**—F. Lippich.

**Figures of Sound formed by Vibrations of Air.**—F. Melde.

**Observations made on the Gas-Flame issuing from an Argand Burner after Removal of the Glass Chimney.**—E. Reusch.

**Improved Electric Light Regulator.**—G. Mos.—Illustrated by engravings.

**Influence of Musical Vibrations on the Magnetism of Iron.**—Dr. Warburg.

**Absorption-Spectrum of Iodine Vapours.**—R. Thalén.

**Minimum Diversion of a Ray of Light with Symmetrically-Arranged Prisms.**

**Chemical Composition of an Ancient Bactrian Coin.**—P. Dewilde.—This coin contains, in 100 parts—Copper, 77.585; nickel, 20.038; cobalt, 0.544; iron, 1.048; tin, 0.038; silver, a trace; sulphur, 0.090—total, 99.343. This composition, the author observes, is very nearly that of the present current coin (25 centimes pieces) of Belgium, which contain 74.4 per cent of copper and 25.55 of nickel.

**Feeble Electric Sparks.**—P. Riess.

**Complicated Pendulum Motion.**—Dr. Emsmann.

*Berichte der Deutschen Chemischen Gesellschaft zu Berlin*, No. 7, 1870.

At the opening of the Meeting of the 11th of April last, the President of this Society, Dr. C. Rammelsberg, alluded, in a brief but expressive speech, to the loss suffered by the death of Dr. G. Magnus. This number contains, in addition to the papers and memoirs to be mentioned presently, biographies of the late Drs. Werther and Erdmann, which, however, are not suitable for further mention here.



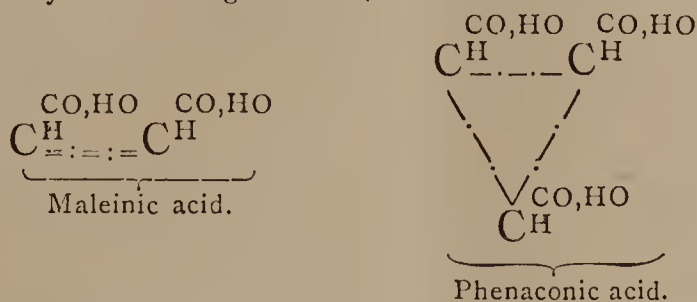
**Formation of Chlormaleinic Acid from Benzol.**—L. Carius.—Chlormaleinic acid,  $C_4H_3ClO_4$ , is a crystalline, white-coloured, solid substance; readily soluble in water, alcohol, and ether; fuses at about  $171^\circ$ ; and, when heated to  $180^\circ$ , is converted into an anhydrous, oily fluid, which, in contact with water, yields again the solid hydrated acid; by the action of hydriodic acid at  $120^\circ$ , it is converted into ordinary succinic acid. Chlormaleinic acid is bibasic; its neutral alkaline salts are readily soluble in water. The acid potassa salt is a hard crystalline substance,  $C_4H_2ClKO_4.OH_2$ . The acid is formed when benzol is acted upon with the hydrate of chlorous acid.

**Preparation of Dibromacetic Acid.**—L. Carius.—The method alluded to is based upon the use of acetate of ethyl, instead of acetic acid; the action of the bromine upon the former is more regular, and the result is the formation of dibromacetic acid, bromethyl, and hydrobromic acid—



In order to execute this process, acetate of ethyl and bromine are mixed in the proportion of  $C_4H_8O_2 : Br_4$ ; and this mixture is heated to from  $120^\circ$  to  $130^\circ$  in sealed tubes. These, after the end of the operation, should be opened, being at the same time placed in ice-cold water, in order to prevent the too sudden evolution and escape of the hydrobromic acid.

**Maleinic and Phenacetic Acids.**—L. Carius.—This paper chiefly treats on the constitution of the acids alluded to, which the author expresses by the following formulæ:—

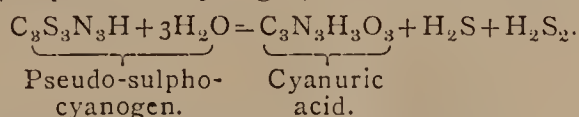


**Simple Mode of Formation of Acrylic Acid.**—W. von Schneider and E. Erlenmeyer.—Owing to the very lengthy and complicated formulæ met with in this paper, it is not suited for abstraction.

**Persulphocyanic Acid and Pseudo-Sulphocyanogen.**—L. Glutz.—The author records his researches on the action of reducing agents upon persulphocyanic acid,  $C_2S_3N_2H_2$ , whereby he has obtained hydriodic acid of sulpho-urea,  $CSH_5N_2I + CS_2$ . When aniline acts upon persulphocyanic acid, there is formed a peculiar crystalline compound—



Pseudo-sulphocyanogen has been considered to be free from oxygen. The author's researches, described at length, have led to the following formulæ, which prove that, when pseudo-sulphocyanogen is heated to about  $140^\circ$  in a sealed tube, it yields cyanuric acid, per-sulphide of hydrogen, sulphuretted hydrogen, and chloride of ammonium—



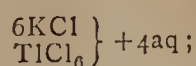
**Researches on the Glycerine Compounds.**—L. Henry.—This paper, a continuation of a former paper on this subject, is divided into the following sections:—On chloro- and bromo-nitro ether of glycerine; direct combination of the allyl compounds with chloride of iodine and hypochlorous acid; hypochlorous acid.

**Transparency of Sulphuret of Lead (Galena) in Thin Plates.**—L. Henry.—After referring to some well-known facts of transparency of metals in thin leaves, the author states that he accidentally discovered that galena in thin plates is transparent, transmitting light with a brownish yellow hue. The only heavy metallic sulphurets hitherto known as transparent are auripigmentum (sulphide of arsenic) and cinnabar (sulphide of mercury); galena, however, is distinguished from both these substances by possessing a metallic appearance.

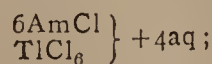
**Tin Compounds.**—A. Ladenburg.

**Manufacture of Artificial Alizarine.**—H. Caro, C. Graebe, and H. Liebermann.—This is the German text of the English patents on this subject, dated June 25th, 1869.

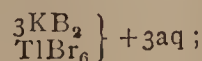
**On the Place to be Assigned to Thallium among the Elements.**—C. Rammelsberg.—After referring to the difficulty of properly qualifying the place thallium should hold among the elements, the author describes the following salts of this element at length, viz.:—Thallium iodate,  $TlIO_3$ ; dithallium iodate,  $Tl_2O_{18} + 3aq$ ; thallium periodate; dithallium periodate,  $Tl_2I_2O_{16} + 30aq$ ; potassium-dithallium chloride—



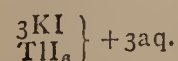
ammonium-dithallium chloride—



potassium-dithallium bromide—



potassium-dithallium iodide—



**Synthesis of Aromatic Acids.**—V. Meyer.

*Bulletin de l'Académie Impériale des Sciences de St. Petersburg*  
Vol. xiv., No. 5.

This number contains only one paper relating to physico-chemical sciences—

**Influence of Heat upon the Elasticity of Caoutchouc.**—J. Schmulewitsch.—The essay is, however, an algebraico-physical one, illustrated by diagrams.

*Annales des Mines*, No. 1, 1870.

This number contains, in addition to its officially-published reports and regulations, the following original memoirs, which are, however, too lengthy for anything more than a quotation of the titles:—

**Record of Experiments on the Roasting of Silver Ores containing Sulphurets.**—M. Simonnet.

**Review of the Progress and Discoveries made in Geology during the last Two Years.**—MM. Delesse and De Lapparent.—This comprehensive, but, of necessity, lengthy memoir, is an excellent compilation of everything done in Europe, as well as America and elsewhere, in this department of science.

*Annales du Génie Civil*, April, 1870.

Among a large number of papers on engineering contained in this number, we find the following:—

**Method for Rendering Wood Difficultly Combustible, and for Preserving it when Underground.**—Dr. Reinsch.—The wood, which must not be planed, is placed for twenty-four hours in a liquid composed of 1 part of concentrated silicate of potassa and 3 of pure water. After having been removed from this liquid, and dried for several days, the wood is again soaked in this liquid, and, after having been again dried, painted over with a mixture of 1 part of cement and 4 parts of the liquid above alluded to. After the first coat of this paint is dry, the painting is repeated twice. Of the paint-mixture alluded to, too large quantities should not be made up at once, because it rapidly becomes very dry and hard. Wood thus treated is rendered unflammable, and does not decay underground.

*Bayerisches Industrie und Gewerbe Blatt*, March, 1870.

This number contains the following original papers and memoirs relating to chemistry and allied sciences:—

**Some Considerations on the Selection and Use of Spectacles, especially in Reference to the Construction of the Human Eye.**—Dr. Steinheil.—A lengthy paper, illustrated with cuts and diagrams.

**Formation and Composition of Aniline Colours.**—Dr. L. Janke.—A lecture on this subject, containing, in a moderately-lengthy paper, all that is essential on this subject, perfectly compiled. The paper is too lengthy for abstraction.

**Water-Glass as a Solvent for Coralline.**—C. Puscher.—The author dissolves coralline in a boiling mixture of one part of concentrated water-glass (silicate of soda or potassa of the consistency of a thick syrup) and 4 parts of water, and, after cooling, applies this solution as a paint for wood (white woods containing little or no tannic acid), by preference, paper, toys, artificial flower tissues, &c., to all of which materials this solution of coralline imparts a beautiful carmine-red tint.

*The Journal of the Franklin Institute*, January, 1870.

This number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

**Beerising of Timber.**—A. Ott.—A reply to Mr. Beer on some of the observations made by the author on his (Mr. Beer's) process of timber preservation. This paper contains some very sound observations on the causes of the decay of wood, and the uselessness of any simple coating to preserve that material.

**New Chemical Nomenclature.**—Dr. A. Ott.—Continuation of former papers on this subject. There is added to this paper, a table, embracing all the elementary bodies known with certainty, and their atomic numbers corresponding with the systems of Berzelius and Gerhardt, with new names added, and the names of lowest and highest oxide. As an instance, we only quote H—Name of one atom, "hydral"; name of a molecule (2 atoms), "hydrel"; name of lowest oxide,  $H_2O$ , "hydrelat"; name of highest oxide,  $H_2O_2$ , "hydrelt."

**Eclipse Observations at Mattoon, Illinois, U.S.**—Dr. G. W. Hough.

**Electricity in Plants.**—E. Smith.—A series of records of experiments on this subject taken, from the CHEMICAL NEWS.

February, 1870.

This number contains the following original items, papers, and memoirs:—

**The Rider Vertical Engine and Valve.**—Although not strictly a subject belonging to the matter generally treated by us, we call attention to this novelty, of American origin, illustrated by excellently executed woodcuts.

**Use of Calcium Lights.**—W. M. Roberts



Explosion of Fulminating Gold.—W. A. Street.

Nickel Linnæite.—A. R. Roessler.

The last three papers have already been communicated to our columns through the courtesy of Prof. Morton, the editor of the *Journal of the Franklin Institute*.

Electrical Measurements.—Dr. Gould.—This paper is the first instalment of an excellent abstract from a paper on this subject published originally in the "Smithsonian Contributions to Knowledge." The paper is too lengthy for useful abstraction, and illustrated with woodcuts. The experiments made relate to the Atlantic telegraph cables of 1865 and 1866.

Observations on the Planet Jupiter.—Dr. A. M. Mayer.—With a beautiful photo-lithographic coloured print of that planet, as seen on January 5 last, at Lehigh, Pennsylvania, U.S.

*Revue Hebdomadaire de Chimie*, April 28, 1870.

Melting and Sublimation Temperatures of some Poisonous Substances.—W. Guy.—We cannot reproduce all the figures here quoted, but the arrangement is excellent, and is as follows:—(1) Sublimates formed without any previous change of state of aggregation, and giving white vapours; under this head are brought bichloride of mercury, calomel, arsenious acid, and cantharidine. (2) Sublimates after previous fusion, and without leaving any residue—viz., oxalic acid. (3) Sublimate after previous fusion, leaving a carbonaceous residue—morphine and strychnine. (4) Fusion, change of colour, sublimation, deposition of carbonaceous residue, aconitine, atropine, delphine, veratrine, brucine, digitaline, picrotoxine, solanine. (5) Decomposition; slow and partial sublimation; tartar emetic.

Elementary Organic Analysis of Wood to be used as Fire-Wood, after having been Exposed to Wind and Weather for more than a Year.—Ch. Mène.—The author records, in tabulated form, exhibiting in percentages the following particulars:—Water, carbon, hydrogen, oxygen, nitrogen, and ash for ten different kinds of woods.

Analysis of some Residues of the Operations of Malting and Brewing.—MM. Nivoit and Lefrange.—The authors exhibit, in tabulated form and in percentages, the analysis of the offal of malting—viz., the rootlets and plumules of the barley, the exhausted barley, dregs, after the infusion, and the exhausted hops—giving for each the full analysis of the ash therein contained, and making some useful suggestions as to the use which can be made of these materials.

Some Applications of Sympathetic Inks.—M. Mendis.

Bibliography.

This number ends with the review of "Éléments de Chimie Minérale ou Synthétique," par Dr. Sacc, at Neuchâtel. This book, published by Lacroix, at Paris, is very highly spoken of as a most excellent text-book for beginners. The work is especially recommended for medical and pharmaceutical students, engineers, and others, who, though not desirous of becoming professional chemists, want a certain amount of information therein.

*Les Mondes*, May 12, 1870.

Submarine Forest.—Dr. Quenault.—The author states that he has discovered, near Hauteville-sur-Mer, close to a rock (in the Atlantic Ocean, and near the French shore), known as *Le Manlien*, a layer of peaty material, wherein are imbedded trunks of trees, yet held by their roots. Although at a depth of 12 metres under water, the oak is in perfect state of preservation, but all other kinds of wood have become soft and spongy. The author supposes that this forest was submerged in the 8th century.

Sugar Manufacturing Industry in France.—From a brief note on this subject, it appears that no less than eighty-nine new beet-root sugar works are in course of construction, while the acreage of land for the purpose of cultivating beet-root this season is larger than it has ever been.

Saccharate of Hydrocarbonate of Lime.—Dr. Felz.—This author states that, having thoroughly investigated this subject, he has found that there does really exist a peculiar compound of sugar and a specific hydrocarbonate of lime ( $\text{CaO}, \text{CO}_2, 5\text{HO}$ ), but that this compound is of a very ephemeral existence, since even a slight exposure to atmospheric air causes its decomposition, by the presence therein of carbonic acid. The utility of this compound in sugar refining is, however, very doubtful, since the author found that, unless very great care and skill are applied, large quantities of sugar may be lost.

Improved Holtz's Machine.—Rev. Father Secchi, S.J.—The eminent author states, in a letter addressed to the editor of *Les Mondes*, that Father Provenzali has greatly improved the instrument alluded to, and describes at some length, the effect of these alterations.

Steam-Engine for Domestic Use.—M. Fontaine.—The author describes at length, and illustrates with several woodcuts, this very useful contrivance. The makers are MM. Mignon and Rouart, Rue Oberkampf, 149 and 151, Paris. According to the description given, and the testimony of no less, already, than 100 owners of these engines, they are the most perfect hitherto brought out. It is stated, incidentally, that, with a consumption of 700 litres of coal-gas per hour, used as fuel (which is equal to 600 grms. of coal), 1-10th actual horse power is readily obtained. This result, the editor of the paper states, is very satisfactory indeed, considering the very small toy-like size of these engines.

## NOTES AND QUERIES.

Indigo-Carmine.—Can any of your readers give me any information about the making of indigo-carmine?—J. D. S.

Lead Chromate.—Can any one assist me in the following difficulty:—I am desirous of preparing some lemon-coloured lead chromate—that is to say, the lead chromate as light in colour as possible. I have followed the directions given in books, by using dilute solutions of a neutral lead-salt and potassium chromate, taking care, also, to have the lead-salt slightly in excess. The precipitate falls of the desired colour on the first reaction; but, after washing by decantation for a few times, from day to day, it gradually becomes darker and darker in colour, until the orange chromate seems produced.—COLOURMAN.

Valuation of Gas Coal.—(Reply to "P. H.")—Take 100 grains of the coal, in small lumps, so that they may be readily introduced into a rather wide combustion-tube. This, at its open end, is (after the coal has been put in) drawn out, so as to form a narrow tube, which is to be bent at right angles; this narrower open end is to be placed in a wider glass tube, fitted tight into a cork fastened in the neck of a somewhat wide-mouthed bottle serving as tar vessel (hydraulic main of the gas-works). The cork alluded to is perforated with another opening, wherein is fixed a glass tube bent at right angles for conveying the gas, first through a chloride of calcium tube, next through a Liebig's potash-bulb, containing a solution of caustic potassa, wherein oxide of lead is dissolved. Next follows another tube, partly filled with dry caustic potassa, and partly with chloride of calcium; from this last tube, a gas delivery-tube leads to a graduated glass jar standing over a pneumatic trough, and acting as gas-holder. Before the ignition of the glass combustion-tube containing the coal is proceeded with, all the portions of the apparatus are carefully weighed, and next joined by means of india-rubber tubing. After the combustion is finished, which should be carefully conducted, so as to prevent the bursting, or blowing-out of the tube, the different pieces of the apparatus are disconnected and weighed again. You thus get the quantity of tar, ammoniacal water, carbonic acid, and sulphuretted hydrogen (as sulphide of lead); and you measure the gas by immersing the jar in water, causing it to be at the same level inside and out. Empty the Liebig's bulbs into a beaker-glass, and separate the sulphide of lead by filtration; wash carefully, and dry at 100° (of course you require for this either a previously dried and weighed filter or a counterpoise filter), from the sulphide of lead you calculate the sulphuretted hydrogen. This process, devised by the late Dr. T. Richardson, of Newcastle-on-Tyne, was found by him (by a lengthy and extensive practice) to yield very reliable results, so as to be suitable for stating what quantity of gas a ton of coal thus analysed would yield. The combustion-tube has to be weighed with the coal after it has been drawn out at its open end, and with the coke after the end of the combustion when it is again cold; and for that reason care is required in managing it.

## MEETINGS FOR THE WEEK.

MONDAY, 23rd.—London Institution, 4.

Geographical, 8.30.

TUESDAY, 24th.—Institution of Civil Engineers, 8.

Ethnological, 4. Anniversary meeting.

Royal Institution, 3. Prof. Seeley, "On History."

WEDNESDAY, 25th.—Society of Arts, 8.

Geological, 8.

THURSDAY, 26th.—Royal Institution, 3. Prof. Tyndall, "On Electricity."

Zoological, 8.30.

Philosophical Club, 6.

London Institution, 7.30.

FRIDAY, 27th.—Quekett Microscopical Club, 8.

Royal Institution, 8. Principal Dawson, "On Primitive Vegetation."

SATURDAY, 28th.—Royal Institution, 3. Prof. Grant, "Astronomy of Comets."

Quekett Microscopical Club. Excursion to Chiselmhurst. To Meet at Charing Cross Station, at 2 o'clock.

## TO CORRESPONDENTS.

J. S. Norie, Sydney.—Received.

Thomas Rowan.—As a rule, we would prefer not to insert letters in these columns which refer to advertisements.

J. W. Slater.—M. Coez's process for the preparation of extracts from dye-stuffs will be found in the *Bulletin de la Société d'Encouragement pour l'Industrie Nationale* for 1867, 2e série, t. xv., p. 745.

John Hughes.—Consult either "The Nature and Properties of the Sugar-Cane, with Practical Directions for Cultivation and Manufacture of Products," published by Smith, Elder, and Co.; or, "The Sugar Planters' Manual," by Dr. Evans (2 vols.), published by Longmans.

### BOOKS RECEIVED.

Science for the People. By Thomas Twining, V.P.S.A. London: C. Goodman, 407, Strand.

Lecture Notes for Chemical Students. By Edward Frankland, F.R.S. Vol. I. Inorganic Chemistry. (Second edition.) London: John Van Voorst, Paternoster Row.



# THE CHEMICAL NEWS.

VOL. XXI. No. 548.

## GOLD REFINING BY CHLORINE GAS.\*

By F. B. MILLER, F.C.S.,  
Assayer in the Sydney Branch of the Royal Mint.

(Concluded from p. 223.)

VERY many thousand ounces (upwards of 200,000 ounces) have now been refined by this process; and the mode of operation which has, in practice, been found the most advantageous has been as follows:—

The French crucibles (say, size 17 or 18), duly prepared with borax, having been placed in the cold furnace, and slowly and carefully heated to dull redness, the gold (from 600 to 700 ounces to each crucible) is introduced, and the fire urged until the metal is melted, the necessary generation of chlorine having meantime been commenced by the introduction of a little hydrochloric acid, poured down the safety-tube, into the generators.

In order to fit the pots, and avoid the risk of splitting them by the wedging of the ingots at their contracted bottom, the gold for refining is cast in moulds of a peculiar form. Two inches from one end, the sides and bottom of the iron ingot-moulds converge so as to produce a slipper-shaped ingot, two of which, placed face to face, fit conveniently into the pot.

As soon as the gold is melted, from 2 to 3 ounces of borax in a state of fusion are poured upon its surface. If the borax is added sooner, it acts too much on the lower part of the pot; and, if thrown in cold, is apt to chill the gold. The clay pipe which is to convey the chlorine to the bottom of the melted gold is now introduced. (It is necessary to carefully heat the lower portion of this pipe for some ten minutes before introducing it into the molten gold, or it is apt to split). At the moment of its entering the melted gold, the screw compression-clamp is slightly loosened, so as to allow a small quantity of gas to pass through it, and thus prevent any metal rising and setting in the pipe, which is then gradually lowered to the bottom of the molten gold, where it is kept by means of a few small weights attached to the top. The compression-tap is now quite relaxed, and the gas is heard bubbling up through the melted metal, which it does quietly and without projection of globules from the pot.

Sufficient hydrochloric acid must be added to the generators, from time to time, to keep up a rapid evolution of chlorine. A rough general rule is to allow 1 imperial quart of acid of 1.15 sp. gr. to every 10 ozs. of silver in the alloy operated on.

The column of liquid in the safety-tube, acting, as it does, like a barometer, affords a ready means of knowing the pressure in the generator, and of judging of the rate of production of the gas, as well as at once showing, by its fall, if anything irregular has occurred—such as a leak or a crack of the chlorine pipe or pot. From 16 to 18 inches in the safety-tube correspond to and balance 1 inch of gold in the refining-crucible. When the chlorine is first introduced into the melted gold, a quantity of fumes are seen to pass up from the holes in the crucible-lid: these are not chloride of silver, but the volatile chlorides of some of the baser metals, and they are especially dense when much lead is present in the alloy under treatment, forming a white deposit on any cold substance presented to them. After a time, longer or shorter, according to the impurities in the gold, these fumes cease. So long as any decided quantity of silver

is present in the molten gold, the whole, or nearly the whole, of the chlorine is absorbed, little, if any, appearing to escape, and to be thus wasted; and it is found that the better the supply of chlorine the quicker is the operation.

It is a curious circumstance that, though, in toughening with corrosive sublimate, this substance is only thrown on the surface of the melted gold, yet the whole mass is toughened by its action. It seems essential, in using chlorine, that the gas should pass to the very bottom to effect a complete refining.

As soon as the operation is nearly over, fumes of a darker colour than those observed at the commencement make their appearance; and the end of the refining is indicated by a peculiar flame or luminous vapour of a brownish yellow colour (occasioned by the free and now waste chlorine escaping), which can be seen on removing a small plug which fits into a hole in the lid of the pot. This, however, of itself, is not a sufficient indication: the process is not complete until this flame imparts to a piece of white tobacco-pipe, or similar substance, when held in it for a moment, a peculiar reddish or brownish yellow stain; so long as it gives any other colour, the refining is unfinished.

When these appearances are observed (usually for gold containing about 10 per cent of silver in about an hour and a half from the introduction of the chlorine), the gas is shut off, and the pots removed from the fire, the white crucible lifted out of the black one, and, together with its contents, allowed to stand seven minutes, until the gold becomes cool enough to set or solidify. The chloride of silver, which remains liquid much longer, is then poured off into iron moulds. The crucible is then inverted on an iron table, when the still red-hot gold falls out in the shape of a cone; this is slightly scraped, and then thrown, hissing, into a concentrated solution of common salt, to free it from any adherent chloride of silver.

An alloy containing originally 89 per cent of gold, 10 per cent of silver, and 1 per cent of base metals, will yield, on an average, a cake of chloride weighing, with a little adherent borax, 16 ozs. for every 100 ozs. operated on.

It is necessary very carefully to dry and heat the moulds into which the chloride of silver is poured, as the slightest moisture causes the latter to be violently dispersed while red hot, to the great risk of the bystanders. With ordinary care, this will never happen; but attention is called to the point, as a very deliquescent chloride of iron is apt to form on the moulds.

The gold is now fine, and simply requires re-melting into ingots.

As before stated, it is found that all these operations can readily be performed, and about 2000 ozs. refined per day in three common melting-furnaces, between 9 a.m. and 2 p.m. 98 per cent of the gold originally contained in the alloy operated on is then ready for delivery.

The other 2 per cent remains with the chloride of silver, partially in the metallic state, and partly in a state of combination with chlorine, and probably silver.

To free the chloride of silver from this combined gold (that mechanically mixed being eliminated at the same time), it is melted in a boraxed white pot, with the addition of from 8 to 10 per cent of metallic silver, rolled to about  $\frac{1}{8}$  inch thickness. The chloride of gold is, by this means, reduced at the expense of the metallic silver, chloride of silver being formed; while the liberated gold sinks, and melts into a button at the bottom of the pot. As soon as the whole is thoroughly melted, the pot is removed from the furnace, and allowed to stand about ten minutes; and the still liquid chloride of silver is then poured into large iron moulds, so as to form slabs of a convenient thickness for the next operation, that is, its reduction to the metallic state.

After the fusion of the chlorides, a small quantity of a curious spongiform substance adheres to the sides of the crucible used, probably consisting of subchloride of silver; but, since it always contains a little gold, care has to be

\* Read before the Royal Society of Victoria.



taken in pouring off the fluid chlorides, to prevent this auriferous sponge from falling out and mixing with them.

The fusion of the chlorides with metallic silver does not remove every trace of gold; but, with proper care, the amount remaining in the silver produced need not exceed 3 parts in 10,000, or about 2 grains of gold in every pound (troy) of silver—a quantity too small to pay for further extraction in this colony.

The slabs of chloride of silver are reduced, without difficulty, by plates of wrought-iron or zinc, in the usual way; but my friend and colleague, Dr. Leibius, has contrived a very excellent apparatus for this purpose.

The Manager of the Bank of New South Wales has kindly allowed me the use of 500 ozs. of Queensland gold to illustrate this paper. This quantity was divided into two nearly-equal parts: one portion, weighing 248 ozs., was left in its original unrefined condition, as seen in the ingot on the table; the other portion, weighing 252 ozs., was refined in the manner described above, and the resulting bar of fine gold, assaying 995, is placed by the unrefined ingot for comparison, and the silver extracted, weighing 38.8 ozs. and assaying 991.1, lies beside it.

Besides the separation and recovery of the silver as above described, another useful end is gained by this process.

A very large proportion of the gold of Australia (more especially that obtained by amalgamation from our quartz-veins) is more or less brittle—an effect generally due to the presence of small quantities of lead or antimony, rendering the bullion quite unfit for coinage or manufacture until it has undergone some process to render it tough.

The methods usually employed for this purpose are either fusion with nitre and borax, melting with oxide of copper, or the addition of corrosive sublimate (bichloride of mercury) to the melted gold. The two former of these plans are troublesome, from the corrosive action they exert on the crucibles; and the last (namely, the employment of corrosive sublimate, which is that usually adopted) is most objectionable, from the dense and highly injurious fumes evolved.

In Victoria, this is regarded as so serious a matter, in a public and sanitary point of view, as to have induced the Municipal Council of Melbourne to institute an action at law against the Union Bank, to compel them to abate the nuisance thus created by their gold-melting establishment. The passage of chlorine-gas through the melted gold is found to effect the complete toughening of the metal by the elimination, as volatile chlorides, of the materials which render it brittle, while the evolution of the deleterious mercurial fumes is avoided.

In the metallurgic treatment of the precious metals, some loss is always sustained; but that incurred in the process here described is not found to be excessive.

The average loss of gold in operating hitherto has been found to amount to 19 parts in every 100,000 of alloy treated, which is considerably less than would be met with in toughening an equal amount of gold with corrosive sublimate in the ordinary manner.

The loss of silver has amounted to 240 parts in every 100,000 of alloy operated on (containing, originally, say 10 per cent of silver).

There is no doubt that a considerable portion of both these losses would be recovered on further treating the pots and ashes remaining after the operation; and it is found that, as manipulatory skill is acquired, the proportional loss of silver appears to be decreasing.

In refining, on the large scale, gold containing 10 per cent of silver, the cost of the operation in Sydney, including labour and the above losses of gold and silver, but exclusive of rent of premises and superintendence, is about five farthings per ounce, but varying with the quantity of silver present in the alloy operated on.

In England, where hydrochloric acid is a waste product of the alkali-works, and all apparatus is cheaper, the cost of refining by this method would be proportionally less.

The fineness of the gold produced by this process varies from 991 to 997 in 1000 parts, the average, as found on a refining of many thousand ounces, being 993.5, or 23 carats, 3½ grains. The remaining 6½ thousandths are silver; and this compares favourably with any of the previously known practical processes, none of which leave less silver than this in the resulting fine gold.

If the refined gold be subjected to a *re-refining* by chlorine, the amount of silver left in it can be reduced to 0.2 per cent, just as in the refining by the ordinary sulphuric acid process the same result can be obtained by subjecting the refined gold to a further refining with bisulphate of potash. For practical working, however, this would probably never be attempted.

The silver resulting from this method of refining is tough, but its quality varies somewhat according to the gold originally operated on: if the alloy treated contains much copper, the greater part of this remains with the resulting silver, but the other metals are nearly all eliminated.

The fineness of the silver hitherto obtained has varied from 918.2 to 992.0 in 1000 parts, the average being 965.6.

Analysis of the silver resulting from the refining of gold known originally to have contained, amongst the base metals in the alloy, copper, lead, antimony, arsenic, and iron, gave the following results:—

Silver	..	..	..	..	..	..	972.3
Copper	..	..	..	..	..	..	25.0
Gold	..	..	..	..	..	..	2.7
Zinc and iron	..	..	..	..	..	..	traces
							1000.0

A very extended series of experiments have been made at the Sydney Branch of the Royal Mint to test the value of this process; and the result has been (as mentioned by the Hon. the Colonial Treasurer, in his speech on the Budget, Oct. 14th, 1869) that “active steps are now being taken to bring the system into operation” in that establishment.

I have already, in the paper read before the Chemical Society, acknowledged the obligation I feel under to my brother officers, Mr. Robert Hunt and Dr. Leibius, for their kind help and encouragement in perfecting this process of refining; but my especial thanks are also due to Professor Smith, of the Sydney University, who, in the kindest manner, placed his laboratory at my disposal, to assist me in this matter, and also to Dr. Thomson and Mr. Edward Hill, for their valuable and friendly help.

## ON THE SULPHO-ACIDS OF BENZOL.

By A. ROSS GARRICK,  
Balyett, Stranraer, Scotland.

BENZOL furnishes a large number of substitution products, some of which have already been subjected to exact investigation, whereas still many remain comparatively unstudied, or, at most, but superficially; of these latter, the sulpho-acids form one series. A few members have been prepared and partially examined, but their connection with each other, and with corresponding derivatives of benzol, is as yet entirely uninvestigated.

Standing first in order of this series is sulphobenzolic acid,  $C_6H_5SO_3H$ , first prepared by Mitscherlich, in 1834 (*Pogg. Ann.*, vol. xxxi., pp. 283 and 634). It is most readily prepared by bringing together benzol with sulphuric acid, accelerating the action by gentle warming on the water-bath. The crude acid is then neutralised with lead carbonate, and by decomposing the lead-salt with hydrosulphuric acid, and evaporating, the free acid is obtained. It is crystalline, and forms small white four-sided plates, very deliquescent and readily soluble in water and alcohol. The crystallised acid has, according to Otto and Ostrop,

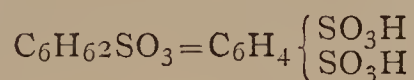


the formula  $C_6H_5SO_3H + 1\frac{1}{2}H_2O$ . It is very stable, and can be boiled with water, with the alkalis, and with most acids, without decomposing. It is monobasic, and forms a series of neutral salts which are mostly well crystalline, all soluble in water, and most of them in alcohol.

In the year 1857, Hofmann and Buckton (*Ann. Chem. Pharm.*, vol. c., pp. 157—161) prepared disulphobenzolic acid from the above acid, by the simple assimilation of the elements of sulphuric acid. They first prepared sulphobenzolic acid, by treating benzol with sulphuric acid, and afterwards decomposing the lead or copper salt with hydrosulphuric acid. They then evaporated the sulphobenzolic acid so prepared on the sand-bath, until the evolution of white fumes proved that the greater part of the water had been volatilised. It was found by them advisable to heat the solution until a slight brown colouration appeared. The acid was then introduced into a dry retort, together with an equal volume of strong Nordhausen sulphuric acid, and the whole maintained at the boiling-point for two hours. The liquid was then reduced, by evaporation, nearly to the original bulk of the sulphobenzolic acid employed. The new acid is described by them as being, at this stage, of a dark brown colour, which cannot be removed by boiling with charcoal. Treatment, however, with an excess of oxide of lead, and decomposition of the filtrate by hydrosulphuric acid, furnished them with a liquid which was perfectly colourless.

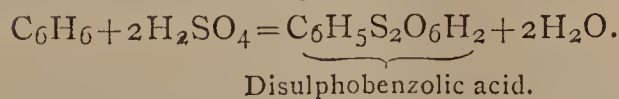
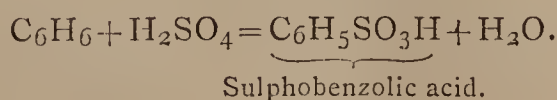
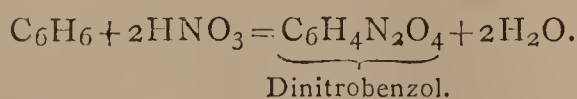
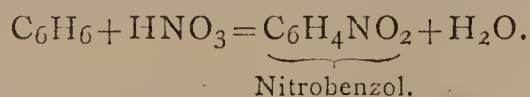
The acid was characterised by them merely by the preparation and analysis of the barium-salt.

The foregoing research of Hofmann and Buckton proves the existence of a bibasic acid, containing two atoms of sulphur, and which, irrespective of any special view regarding its molecular arrangement, may be regarded as formed by the association of a hydrocarbon (corresponding to marsh gas), with two molecules of anhydrous sulphuric acid.



Hofmann and Buckton conclude, as the general result of their investigation of the sulpho-acids, that all organic molecules, particularly in the nascent state, appear to be capable of assimilating the elements of one or two molecules of sulphuric anhydride.

The formation of the two groups of acids which are thus produced presents a great analogy with the production of the nitro-substitutes generated under the influence of nitric acid. All these compounds are generated with the elimination of water. In the action of nitric acid and sulphuric acid upon benzol, for instance, we have—



The action of nitric acid upon organic bodies is by no means limited to the production of the nitro-compounds corresponding to nitrobenzol and dinitrobenzol; frequently additional substitutes are formed with elimination of various molecules of water. Hitherto, however, no substances have been observed in which the assimilation of sulphuric acid has gone farther than in the disulpho-acids.

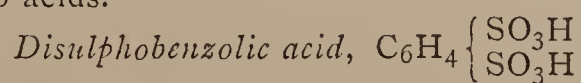
In 1857, Couper succeeded in preparing sulphobrombenzolic acid (*Ann. Chem. Pharm.*, cvi., 226). He first prepared brom-benzol; and, by bringing it together with sulphuric acid, and allowing the mixture to stand, he obtained crystals of sulphobrom-benzolic acid. The acid he describes as being very deliquescent. By the addition

of ammonia to a solution of the acid, he prepared an ammonium-salt of difficult solubility.

These three are the principal sulpho-acids of benzol known at present. Of each of the two latter, according to the theory of Kekulé, three isomeric varieties can exist in which the substituting radicals would have the positions corresponding to the methyl molecules in the three known varieties of xylol or dimethyl-benzol.

With the disulphobenzolic acid, no attempt was made to prepare an isomeric variety. With the sulphobrombenzolic acid, the experiment was tried, which proved successful—an acid of the same composition being produced, which differs from the sulphobrom-benzolic acid of Couper very markedly in a number of characteristics.

With the study of these acids, I have connected the farther object of determining which of the varieties of the diatomic phenols (hydroquinone, pyrocatechin, resorcin) result from these acids by applying the method of Kekulé, Würtz, and Dusart for the preparation of the phenols from the sulpho-acids.



Disulphobenzolic acid is readily prepared by the method of Hofmann and Buckton (*Ann. Chem. Pharm.*, vol. c., pp. 157, 161). For this purpose, sulphobenzolic acid is first prepared by bringing together sulphuric acid and benzol in equal volumes, accelerating the action by gently warming. The lead-salt is then prepared by neutralising a solution of the acid with lead carbonate, evaporating, and crystallising. The salt is then decomposed with hydrosulphuric acid, and, on evaporating the solution, the free acid is obtained. The acid, after being freed from water by allowing it to stand for some time over sulphuric acid, is then introduced into a flask with an equal volume of Nordhausen sulphuric acid, and the whole maintained at the boiling-point for two hours. The liquid, which was very dark in colour, was then dissolved in water, neutralised with lead carbonate, and evaporated. The solution was then decomposed with hydrosulphuric acid, and the lead sulphide filtered off. At this stage, the solution had a reddish colour, which I found was entirely removed on preparing from this solution a lead-salt, and decomposing it with hydrosulphuric acid. The acid so prepared is very deliquescent; it is dibasic, and forms a series of salts which mostly crystallise well and are all soluble in water.

#### SALTS OF DISULPHOBENZOLIC ACID.

*Disulphobenzolate of Lead*,  $C_6H_4(SO_3)_2Pb + 2H_2O$ .

The lead-salt obtained by neutralising a solution of the acid with lead carbonate forms small corny crystals moderately soluble in water.

Water estimation—0.6315 grm. of the salt dried in the air lost, at 110°, 0.0432 grm. = 7.34 per cent  $H_2O$ .

Lead estimation—0.5893 grm. of the dry salt gave 0.4050 grm. lead sulphate = 46.93 per cent Pb.

		Calculated.	Found.
$C_6H_4(SO_3)_2Pb$	..	443	92.49
$2H_2O$	.. ..	36	7.51
		479	100.00
		Calculated.	Found.
$C_6H_4(SO_3)_2$	.. ..	236	53.28
Pb	.. ..	207	46.72
		443	100.00

*Disulphobenzolate of Copper*,  $C_6H_4(SO_3)_2Cu + 4H_2O$ .

The copper-salt forms small blue crystals, closely grouped together, easily soluble in water. At 110°, the crystals give off only a small portion of their water, and the remainder at 140°.



The salt is easily prepared from a solution of the lead-salt by precipitating the lead exactly with a solution of copper sulphate.

Water estimation—0.3515 grm. of the salt dried in the air lost, at 110°, 0.0672 grm. = 19.11 per cent H<sub>2</sub>O.

Copper estimation—0.2843 grm. of the dry salt gave, on ignition, 0.0754 grm. of cupric oxide = 21.16 per cent Cu.

	Calculated.		Found.
C <sub>6</sub> H <sub>4</sub> (SO <sub>3</sub> ) <sub>2</sub> Cu ..	299.4	80.62	—
4H <sub>2</sub> O .. ..	72.0	19.38	19.11
	371.4	100.00	
C <sub>6</sub> H <sub>4</sub> (SO <sub>3</sub> ) <sub>2</sub> ..	236.0	78.83	—
Cu .. ..	63.4	21.17	21.16
	299.4	100.00	

*Disulphobenzolate of Zinc, C<sub>6</sub>H<sub>4</sub>(SO<sub>3</sub>)<sub>2</sub>Zn + 4H<sub>2</sub>O.*

The zinc-salt crystallises in indistinct needles densely grouped together. It is readily soluble in water. To prepare it, the lead-salt is decomposed with that quantity of a solution of zinc sulphate necessary to precipitate the lead.

Water estimation—0.0927 grm. of the salt dried in the air lost, at 110°, 0.0177 grm. = 19.09 per cent H<sub>2</sub>O.

Zinc estimation—0.1393 grm. of the dry salt gave 0.0371 grm. zinc oxide = 21.35 per cent Zn.

	Calculated.		Found.
C <sub>6</sub> H <sub>4</sub> (SO <sub>3</sub> ) <sub>2</sub> Zn ..	301	80.70	—
4H <sub>2</sub> O .. ..	72	19.30	19.09
	373	100.00	
C <sub>6</sub> H <sub>4</sub> (SO <sub>3</sub> ) <sub>2</sub> ..	236	78.41	—
Zn .. ..	65	21.59	21.35
	301	100.00	

*Disulphobenzolate of Barium, C<sub>6</sub>H<sub>4</sub>(SO<sub>3</sub>)<sub>2</sub>Ba + 1½H<sub>2</sub>O.*

This salt forms an apparently amorphous mass moderately soluble in water.

It corresponds to the barium-salt prepared by Hofmann and Buckton (*Ann. Chem. Pharm.*, vol. c., pp. 157—161), and described by them as forming an apparently amorphous mass, which, however, they found under the microscope to be distinctly crystalline, showing minute shuttle-shaped forms generally densely grouped together. When strongly heated on platinum foil, it burned with evolution of sulphurous oxide.

Water estimation—0.1515 grm. of the salt dried in the air lost, at 110°, 0.0100 grm. = 6.60 per cent H<sub>2</sub>O.

Barium estimation—0.2335 grm. of the dry salt gave, on ignition, 0.1432 grm. barium sulphate = 36.53 per cent Ba.

	Calculated.		Found.
C <sub>6</sub> H <sub>4</sub> (SO <sub>3</sub> ) <sub>2</sub> Ba ..	373	93.25	—
1½H <sub>2</sub> O .. ..	27	6.75	6.60
	400	100.00	
C <sub>6</sub> H <sub>4</sub> (SO <sub>3</sub> ) <sub>2</sub> ..	236	63.28	—
Ba .. ..	137	36.72	36.53
	373	100.00	

*Disulphobenzolate of Calcium, C<sub>6</sub>H<sub>4</sub>(SO<sub>3</sub>)<sub>2</sub>Ca + 1H<sub>2</sub>O.*

The calcium-salt is readily soluble in water. It forms an apparently amorphous mass, which, however, on close examination, shows indistinct crystal forms. By neutralising the free acid with calcium carbonate, this salt is prepared.

Water estimation—0.2778 grm. of the salt dried in the air lost, at 110°, 0.0165 grm. = 5.93 per cent H<sub>2</sub>O.

Calcium estimation—0.2613 grm. of the dry salt gave 0.1267 grm. calcium sulphate = 14.24 per cent Ca.

	Calculated.		Found.
C <sub>6</sub> H <sub>4</sub> (SO <sub>3</sub> ) <sub>2</sub> Ca ..	276	93.88	—
H <sub>2</sub> O .. ..	18	6.12	5.93
	294	100.00	
C <sub>6</sub> H <sub>4</sub> (SO <sub>3</sub> ) <sub>2</sub> ..	236	85.51	—
Ca .. ..	40	14.49	14.24
	276	100.00	

*Disulphobenzolate of Potassium, C<sub>6</sub>H<sub>4</sub>(SO<sub>2</sub>KO)<sub>2</sub> + ½H<sub>2</sub>O.*

The potassium-salt crystallises in small colourless distinct crystals. It is easily soluble in water, and is readily prepared from the barium-salt by decomposing it with a solution of potassium sulphate exactly necessary to precipitate the barium.

Water estimation—(1) 0.3648 grm. of the salt dried in the air lost, at 110°, 0.0103 grm. = 2.82 per cent H<sub>2</sub>O. (2) 0.5390 grm. of the salt dried in the air lost, at 110°, 0.0177 grm. = 3.17 per cent H<sub>2</sub>O.

Potassium estimation—0.4432 grm. of the dry salt gave 0.2448 grm. of potassium sulphate = 24.75 per cent K.

	Calculated.		Found.	
			I.	II.
C <sub>6</sub> H <sub>4</sub> (SO <sub>2</sub> KO) <sub>2</sub> ..	314.2	97.22	—	—
½H <sub>2</sub> O .. ..	9.0	2.78	2.83	3.17
	323.2	100.00		
C <sub>6</sub> H <sub>4</sub> (SO <sub>3</sub> ) <sub>2</sub> ..	236.0	75.12	—	—
K <sub>2</sub> .. ..	78.2	24.88	24.75	—
	314.2	100.00		

*Sulphobrom-benzolic Acid, C<sub>6</sub>H<sub>4</sub>BrSO<sub>3</sub>H.*

For the preparation of this acid, the method given by Couper (*Ann. Chem. Pharm.*, vol. cvi., p. 226) was adopted.

Monobrom-benzol was first prepared, and afterwards brought together with an equal volume of Nordhausen sulphuric acid, the action being accelerated by heating on the water-bath. The mixture was then dissolved in water, neutralised with lead carbonate, evaporated, and the lead-salt crystallised. This salt purified by re-crystallisation was then decomposed with hydrosulphuric acid, the lead sulphide filtered off, the solution evaporated and allowed to stand over sulphuric acid. Well-formed radiate crystals were obtained, very deliquescent, which melted at 88°. This acid is monobasic, and furnishes a series of well crystallised salts.

SALTS OF SULPHOBROM-BENZOLIC ACID.

*Sulphobrom-benzolate of Lead, (C<sub>6</sub>H<sub>4</sub>BrSO<sub>3</sub>)<sub>2</sub>Pb.*

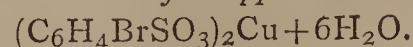
The lead-salt is readily prepared by neutralising a solution of the acid with lead carbonate, evaporating the solution, and allowing the salt to crystallise.

It forms large warty crystals pretty difficultly soluble in water.

Lead estimation—(1) 0.2565 grm. of the salt (110°) gave 0.1143 grm. lead sulphate dried at 100° until constant weight found = 30.44 Pb. (2) 0.6258 grm. of the salt gave, on ignition, 0.2745 grm. lead sulphate = 29.95 per cent Pb.

	Calculated.		Found.	
			I.	II.
(C <sub>6</sub> H <sub>4</sub> BrSO <sub>3</sub> ) <sub>2</sub> ..	472	69.52	—	—
Pb .. ..	207	30.48	30.44	29.95
	679	100.00		

*Sulphobrom-benzolate of Copper—*



The copper-salt forms large thin beautiful monoclinic plates of a blue colour, easily soluble in water. It is pre-



pared from a solution of the lead-salt by precipitating the lead exactly with a solution of copper sulphate.

Water estimation—1.1312 grms. of the salt dried in the air lost, at 110°, 0.1917 grm. = 16.94 per cent H<sub>2</sub>O.

Bromine estimation—0.3410 grm. of the dry salt gave 0.1765 grm. silver bromide = 29.88 per cent Br.

Copper estimation—0.3303 grm. of the dry salt gave, on ignition, 0.0488 grm. cupric oxide = 11.79 per cent Cu.

		Calculated.		Found.
(C <sub>6</sub> H <sub>4</sub> BrSO <sub>3</sub> ) <sub>2</sub> Cu	..	535.4	83.22	—
6H <sub>2</sub> O	.. .. .	108.0	16.78	16.94
		643.4	100.00	
(C <sub>6</sub> H <sub>4</sub> SO <sub>3</sub> ) <sub>2</sub>	.. ..	312.0	58.43	—
Br <sub>2</sub>	.. .. .	160.0	29.73	29.88
Cu	.. .. .	63.4	11.84	11.79
		535.4	100.00	

*Sulphobrom-benzolate of Zinc, (C<sub>6</sub>H<sub>4</sub>BrSO<sub>3</sub>)<sub>2</sub>Zn + 6H<sub>2</sub>O.*

The zinc-salt forms splendid colourless triclinic crystals moderately soluble in water. This salt is readily prepared from a solution of the lead-salt, by precipitating the lead exactly with a solution of zinc sulphate.

Water estimation—0.5688 grm. of the salt dried in the air lost, at 110°, 0.0976 grm. = 17.15 per cent H<sub>2</sub>O.

Zinc estimation—0.4703 grm. of the dry salt gave 0.0691 grm. zinc oxide = 11.80 per cent Zn.

		Calculated.		Found.
(C <sub>6</sub> H <sub>4</sub> BrSO <sub>3</sub> ) <sub>2</sub> Zn	..	537.2	83.27	—
6H <sub>2</sub> O	.. .. .	108.0	16.73	17.15
		645.2	100.00	
(C <sub>6</sub> H <sub>4</sub> BrSO <sub>3</sub> ) <sub>2</sub>	.. ..	472.0	87.89	—
Zn	.. .. .	65.2	12.11	11.80
		537.2	100.00	

*Sulphobrom-benzolate of Barium, (C<sub>6</sub>H<sub>4</sub>BrSO<sub>3</sub>)<sub>2</sub>Ba.*

The barium-salt crystallises in splendid leaflets of a silver glance, easily soluble in water. By neutralising a solution of the acid with barium carbonate, and evaporating, this salt is readily prepared.

Barium estimation—0.3832 grm. (at 110°) gave, on ignition, 0.1451 grm. barium sulphate = 22.33 per cent Ba.

		Calculated.		Found.
(C <sub>6</sub> H <sub>4</sub> BrSO <sub>3</sub> ) <sub>2</sub>	..	472	77.51	—
Ba	.. .. .	137	22.49	22.33
		609	100.00	

*Sulphobrom-benzolate of Calcium—*  
(C<sub>6</sub>H<sub>4</sub>BrSO<sub>3</sub>)<sub>2</sub>Ca + 2H<sub>2</sub>O.

The calcium-salt prepared by neutralising a solution of the acid with calcium carbonate forms large colourless monoclinic crystals with the following forms—

$$\infty P \infty P \infty \frac{P}{2}$$

which effloresce on being exposed to the air.

Water estimation—0.3979 grm. of the salt dried in the air lost, at 110°, 0.0274 grm. = 6.81 per cent H<sub>2</sub>O.

Calcium estimation—0.3695 grm. of the dry salt gave 0.0674 grm. calcium carbonate = 7.29 per cent Ca.

		Calculated.		Found.
(C <sub>6</sub> H <sub>4</sub> BrSO <sub>3</sub> ) <sub>2</sub> Ca	..	512	93.43	—
2H <sub>2</sub> O	.. .. .	36	6.57	6.81
		548	100.00	
(C <sub>6</sub> H <sub>4</sub> BrSO <sub>3</sub> ) <sub>2</sub> ..	..	472	92.58	—
Ca	.. .. .	40	7.42	7.29
		512	100.00	

*Sulphobrom-benzolate of Potassium, C<sub>6</sub>H<sub>4</sub>BrSO<sub>2</sub>KO.*

The potassium-salt crystallises in well-formed rhombic plates, easily soluble in water. It is readily prepared from a solution of the barium salt by precipitating the barium with potassium sulphate.

Potassium estimation—0.4492 grm. of the salt (at 110°) gave 0.4050 grm. potassium-platinum chloride = 14.01 per cent K.

		Calculated.		Found.
C <sub>6</sub> H <sub>4</sub> BrSO <sub>3</sub>	..	236.00	85.79	—
K	.. .. .	39.11	14.21	14.01
		275.11	100.00	

*Isosulphobrom-benzolic Acid, C<sub>6</sub>H<sub>5</sub>BrSO<sub>3</sub>H.*

In order to obtain this acid, sulphobenzolic acid was first prepared. The acid was freed from water by allowing it to stand for some time over sulphuric acid. It was then introduced into a glass tube, together with about 1½ times its weight of bromine, the tube sealed and subjected for several days to a temperature of 100°. The mass was then dissolved in a small quantity of water, and evaporated on the water-bath, until the evolution of hydrobromic acid ceased. The residue was then dissolved in water, neutralised with lead carbonate, and the lead-salt allowed to crystallise. By decomposing this salt with hydrosulphuric acid, filtering, evaporating, and allowing the solution to stand for some time over sulphuric acid, the free acid was obtained. It is exceedingly deliquescent, and, like the former acid, is monobasic, and forms a series of salts, some of which crystallise well.

(To be continued.)

ERECTING THE INVERTED IMAGE IN THE  
MAGIC LANTERN.\*

By Prof. H. MORTON, Ph.D.

A LENS, as everyone knows, inverts the image which it makes of any object; hence, in the magic lantern, we place the picture upside down, and right for left, in order that its image on the screen may occupy a true position. This is the shortest road out of the difficulty, of course, where it can be followed; but there are many cases in which such a treatment of the subject is inadmissible. Thus, if we wish to exhibit to a large audience the manner in which tacks or iron-filings are vivified by a magnet; how water assumes the spheroidal state on a heated surface; how the same fluid is caused to circulate by local changes of temperature, or is decomposed by a galvanic current; or any of the many similar experiments which may be conducted with striking effect in a lantern: we must resort to some means other than "inversion of the object" to secure an erect or right-side-up position of the image on the screen.

The desirability of some means for reaching such a result is very manifest; and the most natural first-thought is to use a square prism, as described by Brewster in his "Optics" (p. 270), where a drawing is given, curious at once for its theoretical accuracy and practical impossibility,—an equilateral triangle being taken to represent a square prism, and the refracting action indicated as about eight or ten times as great as it could possibly be. Yet, viewed as a symbol or hyroglyph, this drawing, as will be shown presently, may be regarded as embodying actual results, which, if known to the author, were certainly not hinted at, and, to the best of our belief, will find their first publication at this time.

A more accurate drawing of the same thing is to be found in Frick's "Physical Technics" (an admirable work, which should be in the hands of every experimenter and manufacturer of apparatus), p. 209.

\* Communicated by the Author.



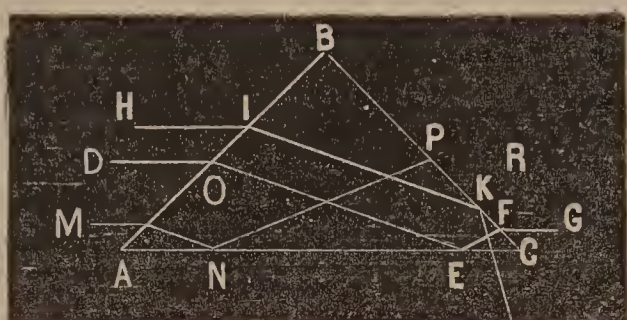
With such authority, we should have proceeded to experiment but for the information, from one who had given much attention to lantern manipulations, that the plan had been tried, and abandoned by him in consequence of the loss of light and reduction of field which it entailed. Prof. R. E. Rogers, who had gone further than we, and had made some experiments, was, we believe deterred from further attempts by the same cause.

A trial, however, was at last made which satisfied us that, under proper conditions, a good result might be realised with a square prism, placed in front of the objective of an ordinary lantern.

The accompanying cut, which is drawn with some attention to accuracy of direction and angle, will show, on inspection, how the upper and under rays, D and M, change places, and thus how the inversion is corrected. In using this prism, no inclination is given to the lantern; it remains directed to the screen, exactly as with the inverted image.

The loss of light experienced is not serious; so that we

FIG. 1.



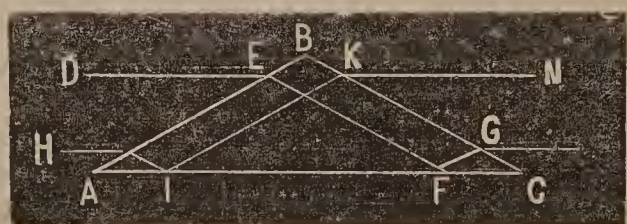
are able, with an ordinary lantern, to cover a screen of 20 feet in diameter with a brilliant circle of light, while the contraction of field, though notable, is not of any practical inconvenience.

The only drawback was the difficulty and cost of obtaining prisms large enough; and this difficulty has been overcome by the ingenuity of Mr. Zentmayer, who has devised the excellent improvement we shall now proceed to describe.

Observing that with the square prism, only the lower portion is available, any ray above D, Fig. 1, such as H, for example, failing to strike the base and be reflected, but suffering reflection downwards at K, and so being lost, he proposed to make the prism of such a shape as is indicated in Fig. 2.

Here the angle B is calculated to equal the angle of refraction of an horizontal ray, such as D at the surface

FIG. 2.



A B, plus  $90^\circ$ . Under this condition, such a ray, after refraction, would be parallel to the further side, B C, and would therefore reach the base, A E, and be reflected from it, however near to the summit, B, it might strike.

The lower ray, H, would be in an equally favourable condition, as is clear from inspection of the figure.

The angle, B, is  $125^\circ 30'$ ; A and C, of course,  $27^\circ 15'$  each. It might be thought that the great obliquity of the surface, A B, would cause a serious loss of light by reflection, but this drawback does not appear in practice.

The economy in thickness of glass required to produce a prism of given effect is decidedly very great. In fact, the ordinary optical glass, which is easily procured, answers perfectly; while for the square prism of sufficient size, it would be necessary to order blocks especially from the foreign manufacturers.

With regard to the curious symbolism of Brewster's drawing, we can now explain, that the rays, after refraction,

were represented as proceeding in lines parallel with the faces of the prism, as in Fig. 2, though with a triangular, or even with a square prism, this was entirely impossible.

We do not wish to claim any originality in the use of a square prism, as above described, but only to call the attention of those interested to the practicability and success of the arrangement. The form devised by Mr. Zentmayer is, however, we believe, entirely new, and certainly most efficient, and he is entitled to all the credit of its invention. —*Journal of the Franklin Institute.*

## PROCEEDINGS OF SOCIETIES.

### CHEMICAL SOCIETY.

May 19th, 1870.

Dr. WARREN DE LA RUE, F.R.S., Vice-President, in the Chair.

Mr. S. H. Johnson was elected a Fellow.

Mr. GRIFFIN exhibited and explained a new gas-furnace, which is capable of melting about 3 lbs. of iron in little more than one hour.

Mr. WALENN described "*A Method for Coating Cast-Iron Objects, by Electrolysis, with Copper or Brass.*"

The peculiarity of his method consists in the circumstance that no hydrogen is evolved during the process. The following is the prescription of an electrolytic-bath for brass:—A mixture of equal parts of ammoniac tartrate and potassic cyanide is saturated with cyanide of zinc and cyanide of copper; and to this solution oxide of zinc and cupric oxide are added. The bath has to be heated, during the process, to about  $80^\circ$ . Several articles (a calico-printing valse, &c.), coated with brass in this manner, were submitted to the inspection of the assembly.

Mr. TOOKEY, Assayer in the Japanese Imperial Mint, communicated a paper "*On the Manipulation of Assays of Gold and Silver Bullion.*"

The number of separate processes, from the first weighing-in of a piece of gold bullion to the second weighing-out, before its value can be ascertained are well known to all assayers. The author had, in connection with the late Mr. Hewny, commenced some operations with the view to treat a batch of assays simultaneously, instead of handling them in rotation and individually, as by the ordinary method. The way pursued by him now is this:—A conical-shaped tube of platinum is closed at its narrower end with a perforated plate; the wider end is provided with a shoulder, so that it can be supported by a porcelain tile having circular holes. The tubes and the holes are numbered, so that each assay can be recognised after the operation. The whole arrangement is then immersed in a vessel containing hydric nitrate (of the proper strength), boiled for the requisite time, &c. In this manner, a great number of bullions may be managed as one assay, and thus a considerable amount of time gained.

A similar reduction in time can also be obtained in the assay of silver bullion by the "dry method." One of the operations in this method is the hammering and brushing of the silver buttons after they have been detached from the cupels. Mr. Tookey employs, instead of this, the following process:—He transfers the silver buttons into the depressed perforated cavities of a platinum plate, fastens each button by means of a handle of platinum wire, and immerses the plate in pure hydric chloride, which is heated until all bone-ash has been dissolved; the plate is then taken out, washed properly, and dried. The cavities of the plate are numbered to correspond with the cupels in the muffle.



Mr. PERKIN read a note "*On some Bromine Derivatives of Coumarin.*"

Bromine combines readily with coumarin, without the evolution of hydric bromide in appreciable quantities; but the product varies according to the manner in which the experiment is performed. The following definite results, however, were obtained:—On adding 1 part of coumarin diffused in carbon disulphide to 1 part of bromine, with several times its bulk of carbon disulphide, the coumarin combines with the bromine; and the compound is, after having allowed the carbon disulphide to evaporate spontaneously, obtained as a crystalline mass, which may be purified by re-crystallisation from alcohol. Crystals thus obtained, dried *in vacuo* and analysed, led to the formula,  $C_9H_6O_2Br_2$ , which shows it to be dibromide of coumarin. It fuses at about  $100^\circ$ , with partial decomposition; and, when further heated, gives off bromine. It is easily soluble in alcohol: this solution is decomposed by heating or exposure to sunlight.

When a mixture of 2 parts of bromine and 1 part of coumarin in carbon disulphide is heated, in a sealed tube, to about  $140^\circ$  for a few hours, a crystalline product is obtained on cooling, and large quantities of hydric bromide are given off on opening the tube. The crystalline substance is separated from the carbon disulphide, and dissolved in boiling alcohol, from which it crystallises out again on cooling. Analysis showed it to be,  $C_9H_4Br_2O_2$ ; that is, coumarin with two of its hydrogen replaced by bromine,—dibromocoumarin. It fuses at  $174^\circ$ , and distils unchanged; it dissolves in boiling alcohol, from which it crystallises in needles. The alcoholic mother-liquor from dibromocoumarin contains a second body, which can be obtained by evaporating off part of the spirit, and re-crystallising the product for several times. The numbers obtained in the analysis agree with the formula  $C_9H_5BrO_2$ ; it is, therefore, bromocoumarin. It fuses at  $110^\circ$ , is more soluble in alcohol than the preceding body, and forms beautiful curved crystals. Both the bromo- and the dibromocoumarin, when boiled with aqueous potassic hydrate, yield potassium-salts of new acids—probably bromo- and dibromocoumaric acids.

Dr. DIVERS gave some remarks "*On the Precipitation of Solutions of Ammonium-Carbonate, Sodium-Carbonate, and Ammonium-Carbamate by Calcium-Chloride.*"

The results of these experiments are chiefly of interest as supplying a characteristic reaction for the carbamate. If, to an aqueous solution of  $NH_3$  and  $CaCl_2$ , a very little of a dilute solution of ammonic carbonate is added, a gelatinous precipitate forms, which soon dissolves, but, after a short time, again re-appears, and assumes a chalky condition. If a somewhat larger quantity of the dilute solution of ammonic carbonate is taken, the precipitate formed at first is permanent. In both cases, however, it takes days till the precipitation is so far complete that the supernatant liquid no longer gives any precipitate on being heated.

Sodic carbonate, under similar circumstances, behaves like ammonic carbonate. If, to a solution of  $CaCl_2$ , which contains no ammonia, some ammonic carbonate is added, the precipitation of the calcic carbonate is very soon completed; already, after one hour, the supernatant fluid fails to give any precipitate on being boiled. It appears, therefore, that caustic ammonia acts here as retarding the precipitation of calcic carbonate.

If a little of a solution of ammonic carbamate (which was obtained by distillation) was added to excess of  $CaCl_2$ , a slight precipitation ensued at once. The supernatant fluid still gave, after two hours, a slight precipitate on being heated, but did no more after four hours. The supernatant liquid, in the case of ammonic carbonate, would have failed to produce any precipitate after the lapse of one hour.

If ammonic carbamate was added to  $CaCl_2$  in the presence of caustic ammonia, a slight precipitate appeared only after eight hours; and, in days after, the mother-

liquor gave still a precipitate on heating. It thus becomes evident that ammonic carbamate soon passes, in the presence of  $CaCl_2$  and in the absence of  $NH_3$ , into ammonic carbonate; but the addition of  $NH_3$  impedes such a change.

When ammonic or sodic carbonate is added in excess to  $CaCl_2$ , a chalky precipitate is formed; and, in less than an hour, the filtered solution gives no precipitate when boiled. Addition of caustic ammonia accelerates the precipitation.

It appears thus that ammonia in the presence of ammonic carbonate determines the precipitation of calcic carbonate, instead of impeding it, as it does in the presence of calcic chloride. Sodic carbonate behaves similarly to ammonic carbonate. The distinguishing reaction, therefore, between ammonic carbamate and ammonic carbonate is that, added in excess to ammonia and  $CaCl_2$ , the calcium is precipitated very slowly in the cold by the former, while it is precipitated immediately by the latter.

Dr. THUDICHUM made a short communication about having obtained hydric acetate from fresh urine,—a fact contrary to the statements of Berzelius, Lehmann, and Liebig.

## ROYAL INSTITUTION OF GREAT BRITAIN.

*Notes of a Course of Seven Lectures on Electrical Phenomena and Theories.* By Professor TYNDALL, LL.D., F.R.S., (Lecture II.)

It is necessary to our further progress to have clear and definite ideas as to the character of the magnetic force.

28. The magnetic power of a magnet, or of a magnetic needle, though really distributed throughout its mass, appears to be concentrated at two points near the ends. These points are called the *poles* of the magnet or needle.

29. The magnetic power of the earth is, doubtless, also distributed through the mass of the earth, but a concentration similar to that just noticed endows the earth also with magnetic poles.

30. The action of the earth upon a magnetic needle is this; the north terrestrial pole repels one end of the needle and attracts the other; the south magnetic pole also attracts one end of the needle and repels the other. But the end attracted by the north terrestrial pole is repelled by the south, while the end attracted by the south is repelled by the north.

31. Thus to each terrestrial magnetic pole the needle presents two ends which are differently endowed. Two opposite kinds of magnetism may be supposed to be concentrated at the two ends. In this *doubleness* of the magnetic force consists what is called *magnetic polarity*.

32. Each of the two distinct kinds of magnetism may be regarded as self-repellent. North repels north, and south repels south. But different kinds of magnetism are mutually attractive; south attracts north and north attracts south.

33. When a magnet, or magnetic needle, is suspended with the line joining its poles *oblique* to the magnetic meridian, the earth's action on the needle resolves itself into what in mechanics is called "a couple," tending to turn the needle into the magnetic meridian.

34. When the needle is in the meridian, the two forces which constitute the couple are equal and opposite. The tendency to produce rotation then ceases; the needle is in its position of equilibrium.

35. When the forces are equal and opposite they must neutralise each other; no *motion of translation* of the needle being, therefore, possible. Thus, when the needle is caused to swim on water, or on mercury, it does not move towards either of the terrestrial magnetic poles.

36. One pole of a bar magnet repels the one end and attracts the other end of a magnetic needle. At the other pole of the magnet the attraction and repulsion are reversed. In the middle of the magnet is the *magnetic*



equator, where neither end of the needle is attracted or repelled.

37. An electro-magnetic helix, even without a core of iron, behaves exactly like a magnet. It attracts iron. Its two ends, moreover, are opposite poles, and between them is a magnet equator. When, however, a core is placed within the helix, the magnetism of the combined system is far more intense than that of the helix alone.

38. The strength of a magnet is measured by its power to deflect a magnetic needle from its meridian; the magnetic strength of a helix alone, and of a helix and core combined, are similarly determined.

39. To obtain the magnetic strength of the core alone, we first determine the strength of the helix alone, then that of the helix and core combined; subtracting the former strength from the latter, we obtain the magnetic strength of the core.

40. If the cores be thick and formed of good iron, the magnetic strength of the core is exactly proportional to that of the helix. A helix of double power will produce an electro-magnet of double strength; a helix of treble power, an electro-magnet of treble strength, and so on. Thus by varying the strength of the helix we vary in like degree the strength of the iron core within it.

41. And here an important point arises. When we allow a core of double power to act upon a piece of good iron, nearly, but not quite in contact with the core, the attraction of the iron is not doubled, but quadrupled. If the core be of treble power, the attraction is not only trebled, but it increases ninefold. If the magnetic strength of the core be quadrupled, the attraction of the iron is augmented sixteenfold. In fact, the attraction is proportional, not to the strength simply, but to the strength multiplied by itself, or to the *square of the strength* of the electro-magnet.

We must be very clear as to the cause of this action, and must, therefore, contrast for a moment the magnetic action of hard steel with that of soft iron.

42. Soft iron is easily magnetised, but it loses its magnetism when the magnetising force is withdrawn. Steel is magnetised with difficulty, but it retains its magnetism even after the withdrawal of the magnetising magnet.

43. This obstinacy on the part of steel in declining to accept the magnetic state, and this retentiveness on the part of steel when the magnetic condition has been once imposed upon it, are called *coercive force*. It is not a happy term, but it is the one employed.

44. Supposing a piece of magnetised steel to possess a coercive force so high as to resist further magnetisation, its attraction by an electro-magnet would be directly proportional, not to the square of the strength but simply to the strength of the electro-magnet.

45. Why, then, does the iron follow the law of the square of the strength? It is because the magnetic condition of the iron is not constant, but rises with the strength of the magnet. When the magnetism of the core is doubled, the magnetism of the iron is also doubled. When the magnetism of the core is trebled, the magnetism of the iron is trebled. The resultant attraction is found by multiplying the magnetism of the iron by the magnetism of the core; and this product is the expression of the law of squares just referred to.

46. To make the matter clearer, let us figure the magnetism of the core as due to particles of magnetism, which are introduced into the core in gradually-increasing numbers. Let us start with a core possessing one magnetic particle, and let it act upon a piece of hard steel, also possessing one magnetic particle: the resulting attraction will be unity or 1. Let two particles be now thrown into the core: the steel, in virtue of its coercive force, remains unchanged, but its particle being now pulled by two particles instead of one, the resulting attraction will be 2. If three particles of magnetism be thrown into the core, all of them pulling at the single

particle of the steel will produce a treble attraction, and so on.

47. Now let us start with a core possessing, as before, a single particle of magnetism, and with a piece of iron also possessing a single particle generated by the core: the attraction, as before, is here unity. On introducing two particles into the core, they generate immediately two particles in the iron. But two particles, each pulled by twice the force first exerted, makes the attraction four times what it was at the outset.

It is to be remembered that every particle is attracted as if the other particles were absent.

48. In like manner, if three particles be thrown into the core, three particles are also generated in the iron. Each of these iron magnetic-particles is pulled by the three particles of the electro-magnet; that is to say, each of the iron particles is pulled with three times the primitive force. But there are three particles so pulled; hence the attraction is nine times what it was at the outset.

49. Let us compare this action for a moment with that of gravity. Two masses of matter attract each other with a force which we shall take as our unit. If the one mass be doubled, the attraction is doubled; if both masses be doubled, the attraction is increased fourfold. If one mass be trebled, the attraction is trebled; if both masses be trebled, the attraction is increased ninefold. When, therefore, both the masses are doubled and trebled, we have the law of squares. Now, it is this doubling and trebling, *in both cases*, of the thing which causes magnetic attraction which causes it to follow the same law.

50. Why do I lead you through these considerations? Simply to make clear to you that, if "the law of squares" here developed shows itself in the action of a magnet upon matter, we may infallibly infer that the condition of that matter is not a *constant condition*, but that it rises and falls with the condition of the magnet. Matter thus affected is said to be magnetised by influence or by induction: it is attracted or repelled (for we shall come immediately to the repulsion of matter by a magnet) in virtue of some condition into which it is temporarily thrown by the influencing magnet.

51. What, then, is the thing that causes magnetic attraction? The human mind has long striven to realise it. Thales (600 B.C.) thought that the magnet possessed a soul. Cornelius Gemma, in 1535, supposed invisible lines to stretch from the magnet to the attracted body—a conception which reminds us of Faraday's lines of force. Cortes di Lodi thought the iron the natural nutriment of the magnet. Descartes embraced magnetic phenomena in his celebrated theory of vortices; and, in our day, Clerk Maxwell has worked in this direction. Æpinus assumed the existence of a magnetic fluid. Coulomb assumed the existence of two fluids, each self-repellent, but mutually attractive. Ampère deemed a magnet an assemblage of minute electric currents, which circulated round the atoms of the magnetised body. These conceptions are sometimes exceedingly useful as a means of connection and classification, even when we do not believe them true. William Thomson deduces magnetic phenomena from "imaginary magnetic matter;" thus giving the mind the conception while distinctly releasing it from belief. The real origin of magnetism is yet to be revealed.

52. Brugmans, in 1778, first observed the repulsion of bismuth by a magnet. In 1827, Le Baillif described the repulsion of antimony. Saigey, Seebeck, and Becquerel also observed certain actions of the kind.

53. In 1845, Faraday generalised these observations by demonstrating the magnetic condition of all matter. He showed that bodies divided themselves into two great classes, the one attracted, the other repelled by the poles of a magnet.

54. To the force producing this repulsion Faraday gave the name of diamagnetism.

What is the nature of this force? Is it inherent and constant? or is it induced?



55. The repulsion of diamagnetic bodies follows accurately the law of squares above developed. A double force produces a quadruple repulsion; a treble force produces a ninefold repulsion, and so on.

56. Hence we may infer with certainty that the condition of diamagnetic bodies, in virtue of which they are repelled by a magnet, is a condition induced by the magnet, rising and falling as the strength of the magnet rises and falls.

57. The force of diamagnetism is vastly feebler than that of ordinary magnetism. Of all diamagnetic substances, for example, bismuth is the most strongly repelled; but its repulsion is almost incomparably less than the attraction of iron. According to Weber, the magnetism of a thin bar of iron exceeds the diamagnetism of an equal mass of bismuth about two and a half million times.

58. Diamagnetic bodies under magnetic excitement exhibit a polarity the reverse of that of magnetic bodies. In all cases whether we operate with helices or with magnets, or with helices and magnets combined, the actions of magnetic and diamagnetic bodies are antithetical.

59. An iron statue standing erect on the earth's surface is converted into a magnet by the earth's magnetism; a marble statue, or a man standing erect, is converted by the same force into a diamagnet; for marble is diamagnetic, and so are all the tissues and all the solids and fluids of the human body. The poles of the man are those of the iron statue reversed.

60. Organic bodies, and most crystals, are magnetised with different degrees of intensity in different directions. They are endowed with *axes* of magnetic induction.

61. Thus in the case of Iceland spar (carbonate of lime), the *repulsion* along the axis is a maximum. In the case of carbonate of iron, a crystal of the same shape and structure as carbonate of lime, the *attraction* along the axis is a maximum.

62. The position assumed by a crystal when suspended between the poles of a magnet, depends on its magnetic axes.

*Erratum.*—In note 20, line 5, for "lay" read "lie" (CHEMICAL NEWS, vol. xxi., p. 211).

## CORRESPONDENCE.

### ANALYSIS OF WATER—STATEMENT OF THE RESULTS.

*To the Editor of the Chemical News.*

SIR,—In the *Journal of the Chemical Society* which is this day to hand, are printed, *in extenso*, the papers read at the Society's ordinary meeting of the 7th of April, and amongst them is that of Professor How, "On an Acid Feed-Water from the Coal-Field at Stellarton, Nova Scotia, and the Results of its Use," which called forth some remarks from myself and others on the occasion of its being read.

The peculiarity herein noted is one sometimes met with in the coal and iron districts of Great Britain, and consists in the occurrence of ferrous salts and small proportions of free sulphuric acid (derived from the oxidation of pyrites) in the mine-water, which has commonly to do duty in the steam-boilers of engines working near the pit's mouth. The "results" are, extensive corrosion of the plates and the formation of ferruginous deposits, both of which, as I pointed out, could be very easily remedied by the use of lime, caustic soda, or other alkali, introduced into the boiler.

There are, however, one or two anomalies in the paper, which seem to have escaped the attention of the author, as well as of the gentlemen composing the "committee of

publication" of the Society's journal. These points I will briefly mention. At pages 157 and 158 are specified the results obtained by the analysis of the objectionable "pond-water" and "well-water"; and in these tables it will be seen that the constituents are arranged in a somewhat anomalous manner—thus, besides other ingredients, there are, in grains per gallon—

	Pond.	Well.
"Sulphate of potash.. .. .	1.53	6.44
Chloride of sodium .. .. .	0.28	0.40
Chloride of potassium .. .. .	0.67	0.88
Free sulphuric acid (oil of vitriol)	1.92	0.43"

In the absence of interfering causes, what circumstances can be assumed to have limited the formation of sulphate of potash to the amounts stated on the first line? Instead of vitriol and alkaline chlorides, why not free *hydrochloric* acid in the water?

Again, at page 159, there are two analyses of boiler deposits given, in each of which "peroxide of iron and a little alumina" are stated to be contained in aggregate proportions, amounting to 54 and 13 per cent respectively. But whence this alumina, since the feed-waters contain none? No mention is made of the existence of alumina in either of the columns specifying the results of the water analyses; silica is there in small quantity, but it is not accounted for in the deposits.

In another place, we are told that "the pond rests upon the measures immediately *underlying* the acadia seam of coal." This must surely be a misprint, for the water was affected by the frost.—I am, &c.,

JOHN SPILLER.

London, May 24th.

### WATER ANALYSIS.

*To the Editor of the Chemical News.*

SIR,—I hasten to disabuse the mind of "Scrutator" of his impression that I lay claim to any originality, either in regard to the volumetric solution named by me, or the mode of marking the termination of the reaction with potassium chromate. I imagined that both these were too well known amongst chemists to make it necessary to mention specially that they were in use at present. Certainly, had I supposed that either were of my own discovery, I should not have called my suggestion "a slight modification of the ordinary volumetric process." I cannot, with "Scrutator," regard an error of 0.1 grain of chlorine on the gallon as of serious importance from a sanitary point of view.—I am, &c.,

THOS. P. BLUNT.

## MISCELLANEOUS.

Effects of the Sun's Heat on a Sand Hill.—Extract from a letter of G. Davidson, Esq., of the Coast Survey, dated U. S. Coast Survey Station, San Buenaventura, Cal., January 23, 1870 (communicated to *Silliman's Journal*, by Mr. D. B. Smith, of Germantown, Pa.):—I have had a very curious experience at this station. It is on the edge of a sandy, steep bluff, seventy feet above the low flat margin that extends 300 yards to the sea beach. At the station, I had an 18 inch theodolite, with three reading microscopes, and was engaged in determining the azimuth of the principal lines of the triangulation from the station San Buenaventura. This involved observations from sunrise to 10 a.m., and from 3½ p.m. to 11 p.m. Imagine my surprise when I found that the heat of the sun pouring all the p.m. upon the south-west face of this bluff so expanded it that the level showed changes as great as 45"! Then in the evening contraction began, and continued until the level at sunrise exhibited changes of 45" the other way. Here



was a change of 1' 30" certainly due to changes of temperature; our lowest temperature was about 40°; our greatest about 79° in the shade, say, 100° in the sun. But this is not all: I was dismayed to find that in cooling during the evening, the tongue of the bluff upon which the station is situated, twisted irregularly in azimuth as much as 18" in three hours. This, of course, vitiated all my results, and I continued a full series simply as an experiment, for I could not change my position for an eccentric one without many drawbacks. I did change my latitude instrument and transit from their positions near the station, and where the same phenomena were exhibited by them. At 102 yards from the edge of the bluff they are as steady as a rock, and I have nothing but the excessive undulations of the heated air to contend with.

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

*Comptes Rendus des Séances de l'Académie des Sciences*, May 16, 1870.

This number contains the following original papers and memoirs relating to chemistry and allied sciences:—

**Solid Cresol.**—A. Wurtz.—300 grms. of toluen are first converted into cresyl-sulphurous acid, the potassa salt of that acid having been fused in a silver vessel with a mixture of potassa and soda, is afterwards decomposed by hydrochloric acid, yielding 200 grms. of crude cresol boiling at between 198° and 204°. On cooling the distillate to a very low temperature, a solid substance was obtained, which, after having been purified by pressing between folds of blotting-paper, and washing with a little ether, is a white crystalline substance exhibiting a strong smell of phenol. It fuses at 34.5°; and if, while in state of fusion, it is simply touched with a piece of solid cresol, it at once again becomes solid. It boils at 201.5°.

**Observation made by Laundresses on the South Coast of Spain.**—M. Guyon.—The author first states that, when the *bochoro* (a southerly wind) blows, the experience of a series of past years has proved, to the laundresses of the country referred to, that the linen always assumes a yellowish hue when hung up for drying or laid down on the grass for the purpose of bleaching. This curious effect is due, the author says, to the fact (also frequently observed in the south of France, along the coast of the Mediterranean) that a southerly wind is almost always accompanied by, or rather the carrier of, a yellowish dust, brought over from the African sandy deserts. There appears, then (that is to say, on such days as the southerly wind blows), to be a kind of mist, or fog, which the late Baron Cloquet, while residing at his country seat at Fort Lamalgue, near Toulon, describes as dry and decidedly dusty. Sailors on board vessels in the Mediterranean are often seriously affected with conjunctivitis, in consequence of being exposed to this dust. It should be borne in mind that the great African desert reaches, in Tripoli, the sea coast, constituting there an extensive sandy beach.

**Use of Milk as Preservative against Lead Poisoning.**—M. Didierjean.—The author, a red-lead manufacturer, states that, having taken all possible precautions to keep their workmen in healthy state, he did not, however, quite succeed in preventing lead colics until, by a mere accident, it was found that two of their men were never affected at all. On inquiry being made, it turned out that they regularly took milk as drink at the time of taking their meals at the works. The owners of the works were thus induced to make the use of milk (1 litre daily) obligatory for their workmen while at the works; and, by exercising a proper surveillance, have succeeded, during eighteen months, of keeping, by this means, all their men free from any symptom of lead disease. The author states that he does not wish to exaggerate, but he vouches for the absolute correctness of his communication.

**The Paris Basin in Pre-Historic Days.**—M. Belgrand.—A lengthy and very interesting geological paper.

**Theory of the Tides.**—M. Roumiantzoff.

**Remarks on the Spectrum of Nitrogen.**—Lecoq de Boisbaudran.

**Maximum of Density and the Freezing-Point of Solutions of Alcohol in Water.**—F. Rossetti.—The mixing of alcohol with water has the effect of bringing the point of maximum density and of freezing of such a mixture nearer to each other; and in a solution containing

14.4 per cent of alcohol, the freezing-point, -7.35°, coincides with that of maximum density.

**Application of Silicate of Potassa for the purpose of Solidifying Fossil Bones.**—M. Farez.—The author applies a concentrated (syrupy) solution of silicate of potassa, in order to lessen the risk of breakage and obviate the porosity of fossil bones to be preserved as specimens in collections.

**Knowledge Possessed by Men of Science concerning Magnetism in the 13th Century.**—M. d'Avezac.—By the study of ancient manuscripts found in the library of the Arsenal at Paris, and carefully collated with facsimiles of these manuscripts extant at Leyden, the author concludes that the phenomena of magnetic declination were already known in the 13th century.

**Composition of the Gas of the Fontaine Ardente of Saint-Barthélemy (Isère).**—F. M. Raoult.—This so-called fountain is the issuing out of the soil of inflammable gas at or near the locality above-named, situated at 25 kilometres south of Grenoble. The author, on visiting this spot, found the gas issuing out from a multitude of fissures in a schistose rock, and burning in some parts. The gas is devoid of smell; it contains, in 100 parts, by bulk—Carbonic acid, 0.58; nitrogen, 0.48; oxygen, 0.10; marsh gas (CH<sub>4</sub>), 98.81; loss, 0.03.

**Note on the Detection of Ammonia and Nitric Acid by means of Rosolic Acid and Bromo-Mercurate of Potassa.**—P. Guyot.—Only the title of this paper is quoted.

*Bulletin Mensuel de la Société Chimique de Paris*, April, 1870.

From the *procès-verbaux* of the meetings of this Society, we learn that, when chloral acts upon aniline, there is formed C<sub>20</sub>H<sub>5</sub>NO<sub>4</sub>. The author, M. Maumené, states that this is an energetic base, soluble in acids, but not yielding crystalline salts.

M. Salet describes an arrangement whereby the detection of sulphur and phosphorus, spectroscopically, is rendered more perfect by causing the flame of hydrogen to be reflected by water running along a bright piece of platinum.

M. Bourgoin states that the accident which took place some time ago in the laboratory of the Hôtel-Dieu (see CHEMICAL NEWS, vol. xxi., p. 191) was solely due to a bad arrangement of the apparatus in use, and, more yet, to the proportion of the chlorate of potassa and peroxide of manganese. The author says, when equal parts, by weight, of these substances are mixed, the gas is regularly given off, and no fusion takes place; but, if only one-half of peroxide be used, fusion will take place, and there will be a sudden evolution of gas with explosive force.

The following original papers are contained in this number:—

**Thermo-Chemical Researches on Bodies formed by Double Decomposition.**—MM. Berthelot and Longuinine.—This very lengthy memoir is sub-divided as follows:—Method; acetic chloride, C<sub>4</sub>H<sub>3</sub>ClO<sub>2</sub>; acetic bromide, C<sub>4</sub>H<sub>3</sub>BrO<sub>2</sub>; acetic iodide, C<sub>4</sub>H<sub>3</sub>IO<sub>3</sub>; butyric bromide, C<sub>8</sub>H<sub>7</sub>BrO<sub>2</sub>; anhydrous acetic acid, (C<sub>4</sub>H<sub>3</sub>O<sub>3</sub>)<sub>2</sub>; formation of anhydrous acids; formation of acid chlorides.

**Laws which Regulate the Division of a Substance between Two Solvents.**—MM. Berthelot and Jungfleisch.

**Laws which Regulate the Division of a Substance between Two Solvents.**—M. Berthelot.—The first of these memoirs contains the lengthy description of the experiments, and the second paper the theory deduced therefrom.

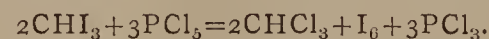
**Researches on the Condition Salts are in when in Solution.**—MM. Berthelot and L. de Saint-Martin.—This memoir contains the following chapters:—Acid salts in solution; division of acids between one and the same base.

**Preparation of Pure Nitrogen.**—M. Berthelot.—Take a bottle or flask of from 10 to 15 litres' capacity; place at the bottom some 200 grms. of pure copper turnings, and pour over these, so as to cover the metal partly, a quantity of liquid ammonia. The bottle is closed by means of perforated cork, fitted with a safety-tube and gas delivery-tube, which latter is, however, closed by means of a caoutchouc tube, shut off with a spring clip. The bottle so arranged is left standing for some days, care being taken to shake up its contents. The oxygen of the air contained in the bottle is completely absorbed, and the pure nitrogen may be readily transferred to another vessel.

**Reaction of Phenol upon Ammonia.**—M. Berthelot.—The author states that, contrary to the general opinion on this subject, his researches, expressly instituted to illustrate this matter, have proved that, under no conditions, ammonia, or compounds thereof, yields any aniline when heated with phenol in sealed tubes.

**Distillation of Super-Heated Liquids.**—M. Berthelot.

**Action of Perchloride of Phosphorus upon Iodoform.**—A. Gautier.—The main result of this reaction is the formation of chloroform—



**Properties of Iodic Acid.**—A. Ditte.—This lengthy memoir is divided into the following sections:—Anhydrous iodic acid; hydrated iodic acid. The author describes, at great length, the preparation, properties, and all reactions of these substances.

*Revue des Cours Scientifiques de la France et de l'Etranger*, May 7, 1870.

Although this number does not contain any papers or memoirs specially devoted to chemistry or collateral sciences, the following paper—



**Scientific Work done in the Departments of France—E. Blanchard.**—Contains particulars which we briefly quote here. Alluding, in the first place, to a long-disputed question—to wit, the alleged identity of composition of all the sulphurous mineral waters met with on the Pyrenees (French side)—the author states that the very careful researches of Dr. Filhol, of Toulouse, have proved the fact that some of these waters, while impregnated with sulphuretted hydrogen, contain an exceptionally-large proportion of carbonate of soda, whereby they are quite alkaline; while others, again, which are very prone to decomposition, contain sulphuretted hydrogen in a peculiar state; lastly, some of these waters contain an abundance of *bare-gine*, a peculiar organic matter. To Dr. Filhol, also, is due the initiative of exploring some of the caverns of the Ariège, and especially the cave of Herm. These labours have brought to light several important facts relating to primitive man, and to such now extinct animals as the *Felis spelæa* and *Ursus spelæus*. The author of this paper speaks highly, and describes, at great length, the very assiduous labours of Dr. P. Rouville, at Montpellier, in reference to an excellent geological map of the Département de l'Hérault (a most interesting part, not only of France, but, generally speaking, for geological discoveries); while the mining engineer, Mallard, has worked in a similar direction for the departments of the Haute-Vienne and Creuse. To both the gentlemen just named, as, also, to M. E. Dumortier, who has likewise excelled in geological labours relating to the right bank of the Rhone and Jura districts, silver medals have been given by the Geological Society of France.

No. 24, 1870:

**The Science of Life.**—Dr. W. Kuhne.—A verbatim, but translated report of the author's lecture at the inauguration of a physiological laboratory in connection with the Athenæum at Amsterdam. We regret that the length of this excellent paper does not admit either its abstraction or full reproduction.

**Parasites of and on the Cereals: Ergot of Rye.**—E. Fournier.—A lecture on this subject, containing a large amount of useful information.

**Composition of the Air (Gas, rather) Given Off by a Chauffer containing Ignited Charcoal.**—Dr. C. Bernard.—The author, while continuing his lectures on asphyxia by vapours of burning charcoal, quotes the following analysis, by Dr. Leblanc, of the gas above named, containing, in 100 parts—Oxygen, 19.79; nitrogen, 75.02; carbonic acid, 4.61; oxide of carbon, 0.54; carburetted hydrogen, 0.04;—total, 100.

*Revue Hebdomadaire de Chimie*, May 5, 1870.

**Apparatus for the Prevention of Steam-Boiler Explosions.**—O. Zabel.—The author gives, as a theory for the cause of these explosions, a superheating, accompanied by a peculiar stagnation of the water in the boilers; and says that, when such a condition occurs, a very slight cause—for instance, even the starting of the engines—may cause a motion in the water, which, being super-heated, is thereby suddenly converted into steam of very high pressure, thus causing the explosion. The apparatus, described at length, is intended to remedy the stagnation of the water, and its consequent super-heating, by keeping it in motion.

**Centrifugally-Acting Rag-Washing Machine.**—W. Ralp.

**Preparation of Sea-Weed, and its application to the Manufacture of Paper.**—J. E. Brizot.—It is rather difficult to make out what kind of sea-weed the author refers to, and this the more so as there are several different species of these plants, and some specifically belonging to the Mediterranean, on the shore of which the author's residence (Toulon) is situated. From the description given, we presume the *Laminaria digitata* is alluded to; and this weed is largely found in some portions of the seas surrounding the British Isles. The weed is washed, the bark, or skin, is removed, as far as necessary, and, thus prepared, placed in dilute sulphuric acid for the purpose of softening the weed, after which it is bleached and made into pulp.

**Ciment Lapidifique Hydrofuge.**—Under this name, MM. Camus and Sons, 2, Rue Barbette, Paris, have for sale a substance, not specified as to its composition, but very highly recommended for its qualities of curing and preventing dampness of walls; and the colour of this material, a bright grey, is such as not to require painting or papering of walls covered with it.

**New Method for the Preservation of Meat.**—The process here described may be summarised thus:—The beasts are killed by causing them to inhale carbonic oxide. As soon as they have become thereby insensible, they are bled; the operations after the killing of the animal are performed as usual. The meat is next exposed in a peculiarly-constructed vessel to an atmosphere composed of nitrogen and oxide of carbon, and afterwards placed in a box over a mixture of sulphurous acid and charcoal. This is Mr. Gamgee's process.

*Cosmos*, May 14, 1870.

**Meteorological Prognostics for 1870.**—Dr. Chapelas-Coulvier-Gravier.—From this paper we quote that, according to the author's scientific investigations, extending some years back, and for sound reasons, based on a series of observations, the temperature this year will be moderate, while rain and dry weather will be successively experienced. There will be no excessive drought. Thunderstorms will be frequent, and, on the whole, the season will be as that of 1862.

Although not exactly belonging to the subjects usually treated of in our paper, we call attention to the following:—

**Important Archæological Discoveries in the Ancient Gaulic Cemetery near Chassemy (Aisne).**

**Peculiar Substance Fallen in the shape of Rain at Genoa on the 14th of February last.**—G. Bocardo.—The material alluded to consisted, in 100 parts, of—Water, 6.490; organic nitrogenised matter, 6.611; sharp sand, mixed with a small quantity of clay, 65.618; oxide of iron, 14.692; carbonate of lime, 8.589. The author also gives the results of his microscopical investigations on this subject, finding the powder to contain several sporulæ of cryptogamic plants, and a substance akin to starch in structure, at least as to the origin of this dust. The author speaks very reservedly, reminding his readers that, according to Captain Maury's observations (as in 1846), dust may blow even across the Atlantic towards the Azores and Southern Europe.

**Anthropophagi of Chauvaux.**—Dr. Spring.—The author relates, at length, his discoveries in the cave of Mount Chavaux, Namur, Belgium, and proves that, at a remote period of man's existence, anthropophagism was very common. This paper is interesting also for the history of primitive man.

*Monatsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin*, February, 1870.

The only papers relating to chemistry of this number are—

**Preparation of Ethylamines on the Large Scale.**—Prof. A. W. Hofmann.

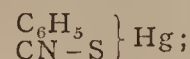
**Desulphuration Products of Diphenyl-Sulphocarbamide.**—Prof. A. W. Hofmann.—Both these papers are too much condensed already to admit of any useful abstraction.

*Journal für Praktische Chemie* (double number), Nos. 4 and 5, 1870

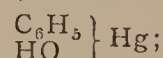
This number contains the following original papers and memoirs:—

**On the Haloid Compounds which Correspond to Picric Acid and Dinitrophenol, and some Derivatives thereof.**—Dr. C. Clemm.—In addition to a lengthy introduction, this memoir contains the following sections:—Action of pentachloride of phosphorus on picric acid; preparation of trinitro-chlorobenzol; trinitro-chlorobenzol and ammonia; trinitro-chlorobenzol and aniline; trinitro-chlorobenzol and ethyl-aniline; trinitro-chlorobenzol and phenol-sodium; trinitro-chlorobenzol and rhodan-potassium; dinitrophenol and phosphor-pentachloride; dinitro-chlorobenzol and ammonia; conversion of dinitro-bromobenzol into dinitro-phenol and into dinitraniline; dinitro-bromobenzol and aniline.

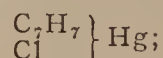
**Some of the Derivatives of Mercurio-Diphenyl, Mercurio-Ditolyl, and Mercurio-Dinaphthyl.**—R. Otto.—This paper treats on acetic acid mercurio-monophenyl; nitric acid mercurio-monophenyl; carbonic acid dimercuro-monophenyl; behaviour of mercurous chloride with mercurio-diphenyl; mercurio-monophenyl-cyanide; mercurio-monophenyl-sulphocyanide—



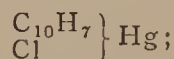
mercurio-monophenyl-hydroxyl—



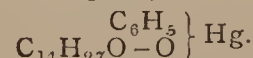
mercurio-monotolyl-chloride—



mercurio-mononaphthyl-chloride—



myristinic acid mercurio-monophenyl—

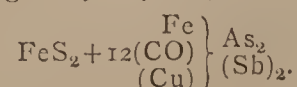


**On Madder.**—Dr. A. Petzhold.—This highly interesting paper contains the tabulated results of the ash analyses of no less than thirteen samples of madder—viz., five samples from Zeeland, and the rest from the Vaucluse.

**On a Rapidly-Executed and Correct Method for the Quantitative Estimation of Nitric Acid in the Potable Waters of Basle, Switzerland.**—Dr. Goppelsroeder.—From the appendix to this rather lengthy memoir, we learn the following about the quantity of nitric acid contained in a litre of snow fallen on the following days of this year:—February 8th, 0.002 grm.; Feb. 12th, 0.0017, and later same day, 0.002; Feb. 21st, 0.002, and later same day, 0.0072; Feb. 22nd, 0.002; March 4th, 0.0016.

**Conversion of Starch by so-called Diastase of Malt.**—Dr. A. Schwarzer.—A lengthy treatise on this subject, containing the results of a number of experiments on the large as well as the small scale.

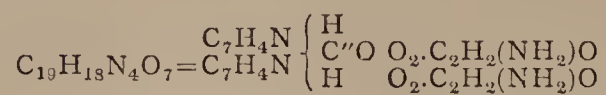
**On Glauconite.**—Dr. F. Sandberger.—This mineral, newly discovered, has a specific gravity of 7.181; its formula is—



It contains, in 100 parts—Sulphur, 2.36; arsenic, 66.90; antimony, 3.59; iron, 21.38; cobalt, 4.67; copper, 1.14.

**New Derivatives of Aromatic Amido Acids.**—P. Griess.—This memoir treats of—Carboxamido-salicylic acid; carboxamido-hippuric acid—





*Polytechnisches Journal von Dingler*, second number for April, 1870.

The first April number, not having come to hand yet, will be quoted afterwards. The above-named number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

**Improved Attwood's Machine.**—C. Occhsle.—This paper is illustrated by engravings. The contrivances, however, are real improvements; and the author, a physical instrument maker, has applied, in an ingenious manner, an electro-magnetic apparatus.

**Improvement in the so-called Chamber Method of White-Lead Manufacture.**—F. Brammer.—By this process, the lead in thin sheets is exposed, in a properly-constructed room, to the joint but alternate action of the vapours of acetic acid (vinegar) and an atmosphere of pure carbonic acid. The author describes, at great length, his manufactory, arranged according to this plan of preparing white-lead, which has the very decided advantage of yielding an excellent product, and, at the same time, preserving the health of the workmen.

**Description of a New Apparatus for the purpose of Replacing the Claying and Liquoring Processes in the Sugar Manufacture and Refining.**—Dr. O. Tech.—The author describes his process and apparatus at length. The main principle is that a column of liquid (in this instance, a very concentrated and fine liquor) exercises, when 32 feet high, a pressure of 15 lbs. to the square inch. This principle is made use of with properly-constructed air-tight apparatus to clear the sugar placed in the moulds in a very short space of time, and with a very considerable saving of labour and materials.

**Chemical Investigation of Several Samples of Condensed Milk (Preserved Milk).**—L. Kofler.—The author has extended his researches over five samples—1, Anglo-Swiss Condensed Milk Company; 2, from Sassin (Prussia); 3, from Vivis (Switzerland); 4, from Kempten (Bavaria); 5, prepared by the author. These samples contain, besides sugar (purposely added to an extent of from 25 to 30 per cent), and milk sugar to from 14 to 18 per cent—

	1.	2.	3.	4.	5.
Water .. .. .	22.180	18.824	22.421	18.810	20.770
Fatty matter (butter)	12.260	12.625	12.030	13.650	12.830
Caseine and albumine	28.100	24.240	25.960	24.900	29.600
Ash .. .. .	2.180	2.482	2.673	2.430	2.865

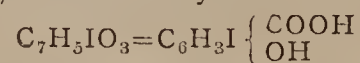
The paper contains a full and lengthy report on these articles, all of which were also submitted to microscopic investigation, and found to be genuine articles, in every respect fit, when diluted with water (in which liquid all these substances were readily soluble in the cold), to be used as milk.

**Abbreviated Method of Designating the Measures and Weights of the Metrical System.**—J. C. Evers.—The author, Inspector of the Netherlands' Government Telegraph Lines, has introduced at the offices, under his orders, the following simple plan:—Myriametre, MM.; kilometre, KM.; hectometre, HM.; decametre, DM.; metre, M.; decimetre, dM.; centimetre, cM.; millimetre, mM.; square kilometre, KM<sub>2</sub>; square metre, M<sub>2</sub>; square centimetre, cM<sub>2</sub>; stère, or cubic metre, S. or M<sub>3</sub>; cubic centimetre, cM<sub>3</sub>; cubic millimetre, mM<sub>3</sub>; kilolitre (1000 litres), KL.; hectolitre, HL.; kilogramme, KG.; gramme, G.; decigramme, dG.; centigramme, cG.; milligramme, mG.

*Annalen der Chemie und Pharmacie*, VII. Supplementband, No. 2, 1870.

This number contains the following original memoirs and essays:—

**Researches concerning the Iodated Salicylic Acids: Oxy-salicylic Acid and Hypogallic Acid.**—Dr. P. Liechti.—This very extensive memoir is divided into the following sections:—Preparation of iodosalicylic acids; mono-iodosalicylic acid—



di-iodosalicylic acid—



oxysalicylic acid—



opinic and isopinic acids.

**Preliminary Notice on some of the Acids which are generated from Salicylic Hydride.**—Dr. Städeler.

**Action of Hydrogen upon Perchloride of Methan.**—Dr. Städeler.

**Dichloride of Phenol, Dichloronitro-Phenol, and Dichlor-amido-Phenol.**—Dr. F. Fischer.

**On Chloronitrophenols.**—A. Faust and E. Saame.

**Orthonitro-Dichlorophenol and an Isomeric Dichlorophenol.**—O. Seifart.

**Reduction of Nitrobenzol by means of Hydrobromic and Hydrochloric Acids.**—Dr. H. Baumhauer.—This memoir contains the following sections:—Action of hydrobromic acid upon benzol; action of hydrochloric acid upon nitrobenzol.

**Description of an Improved Gas Furnace for Elementary Organic Analysis.**—C. Glascr.—Illustrated by lithographs.

**Formation of Iodoform, and Application of this Reaction to Chemical Analysis.**—A. Lieben.

**Mode of Transit of Alcohol into the Urine.**—A. Lieben.

VII. Supplementband, No. 3, 1870.

This number opens with the very lengthy memoir on—

**Anthracen and Alizarin.**—C. Graebe and C. Liebermann.—We can here only quote the chapters of this memoir—Anthracen; hydrides of anthracen; bromine derivatives of anthracen; chlorine derivatives of anthracen; anthrachinon and substituted anthrachinones; alizarin; purpurin; pseudo-purpurin; chrysophanic and chrysaminic acids; constitution of anthracen and its derivatives.

**The Avogadro Law, as Derived from the Mechanical Gas Theory.**—A. Naumann.

**On the Avogadro Law.**—K. Zöppritz.

**Nature of the Chemical Elements as a Function of their Atomic Weights.**—L. Meyer.—Illustrated by lithographs.

*Journal für Gasbeleuchtung*, April, 1870.

Contains—

**Normal Flames for Photometric Use.**—Dr. Schilling.—A series of figures.

**Tar as Fuel in Gas-Works.**—H. Raupp.—Illustrated with engravings.

**Water Supply and Water-Works of the Town of Brunswick.**—W. Claus.—A very complete description and review of this matter.

**Brief Notes on the Water Supply and Water-Works of German Towns.**—Dr. Schilling.

## NOTES AND QUERIES.

**Indigo-Carmine.**—(Reply to "J. D. S.")—Consult the works mentioned in our issue of the March 11th last, under the heading "Colours and Pigments" (p. 120); also Cooley's "Cyclopædia of Practical Receipts," published by Churchill.

**Self-Raising Flour.**—I should feel obliged if any one could give me information as to what material is introduced into flour to constitute it "self-raising." I have made a few rough analyses, but they have resulted in nothing. No carbonic anhydride is given off on treating the flour with water or with an acid.—B.Sc.

**Lead Chromate.**—(Reply to "Colourman.")—The following plan will best answer your purpose:—Take a solution of 33 parts of acetate of lead in 100 parts of water; precipitate this first by a solution of 22 parts of carbonate of soda in 60 parts of water, let the precipitate settle, and then decant the water. Next, add to the precipitate a solution of 17½ parts of neutral chromate of potassa in 50 parts of water; take care to stir this mixture well, and, after collecting on a filter, wash, press, and dry. The chromate thus prepared remains bright yellow, and does not redden by being ground up with water. The process is described at length in Dingler's *Polytechnisches Journal*, vol. lxxxvi., p. 438.

**Fairfax's Test-Papers.**—In justice to chemical students, I think the following points respecting "Fairfax's test-papers" should be made known:—(1) When placed in distilled water, the colouring matter is dissolved out in a few minutes, and leaves the paper so as to be totally unaffected by either acids or alkalies. (2) Sulphuretted hydrogen gas immediately decolourises it, indicating, according to the inventor's directions on the cover, a substance of an alkaline nature. The colour cannot be restored by acetic acid, but by one of the stronger acids, such as sulphuric. (3) The paper is apparently kept moist by chloride of calcium, the result being that the colouring matter stains anything with which the paper is placed in contact. These points scarcely bear out the announcement upon the cover—viz., that it is "the most delicate test for ordinary acids and alkalies," and "litmus superseded."—T. B.

## MEETINGS FOR THE WEEK.

MONDAY, 30th.—London Institution, 4.

TUESDAY, 31st.—Institution of Civil Engineers, 8.

— Royal Institution, 3. Prof. Secley, "On Present English History."

THURSDAY, June 2nd.—Royal Institution, 3. Prof. Tyndall, "On Electricity."

— London Institution, 7.30.

— Royal Society Club, 6.

— Royal, 8.30.

— Chemical, 8. Dr. Odling, "On the Platinum Ammonias."

FRIDAY, 3rd.—Royal Institution, 8. Prof. Max Müller, "Migration of Fables."

— Geologists' Association, 8.

SATURDAY, 4th.—Royal Institution, 3. Prof. Grant, "Astronomy of Comets."



# THE CHEMICAL NEWS.

VOL. XXI. No. 549.

## ON THE PRESENCE OF POTASH IN CHROMATE OF LEAD.

By Dr. T. L. PHIPSON, F.C.S.,  
Member of the Chemical Society of Paris.

ON making the analysis of some organic compounds recently introduced into the arts, it struck me that the carbon determinations obtained by oxide of copper were rather higher than those obtained by chromate of lead. The difference was slight, but nearly sufficient, in one case, to modify the formula deduced from the results.

It then occurred to me that this might be due to a small quantity of potash retained by the fused chromate of lead. I therefore acted upon some 500 grms. of this compound with boiling distilled water, and detected potash in the filtrate in every instance. The samples examined were prepared, I believe, in Germany. Four of them were tested quantitatively, and gave from 0.01 to 0.02 per cent of potash. Although so small, this amount of potash might, in some cases, influence the results of combustion, unless certain precautions are taken, as will be easily seen by taking into consideration the great weight of chromate of lead which enters the combustion-tube, and the small weight of matter usually subjected to combustion in order to ensure complete results.

Taking the most favourable view of the case, the quantity of matter burnt being stated at 0.100 grm., and the quantity of potash existing in the chromate of lead at 0.01 per cent, the quantity of chromate of lead which is used in the ordinary-sized combustion-tubes may be set down at 140 to 150 grms. Let us say only 100 grms. (for this quantity may be reduced to even less). In this case, we should have a certain loss of 1.2 per cent of carbon in the analysis.

The precautions to be taken to avoid error from this source are:—To use a slight excess of lead-salt in the preparation of the chromate, and to wash thoroughly with boiling water; to test occasionally for potash the chromate of lead supplied by commerce for the purpose of organic analysis; instead of 140 to 150 grms. of chromate in the combustion-tube, to take not more than 70 to 75, which may in most cases be easily done by using a narrower and rather shorter tube; and, finally, to take as large a quantity of the substance (0.2 to 0.5 grm.) as can be conveniently or safely taken for the analysis.

In these circumstances, chromate of lead will retain all its superiority over oxide of copper as an agent of combustion.

Analytical Laboratory, Putney, S.W.

## EXPERIMENTS ON THE EFFECT OF ALCOHOL (ETHYLIC ALCOHOL) ON THE HUMAN BODY.\*

By E. A. PARKES, M.D., &c.,  
and  
COUNT C. WOLLOWICZ, M.D., &c.

THE authors, eminent army medical and scientific men, took the opportunity which the willingness and zeal of a very intelligent healthy soldier afforded them, of investigating the subject above alluded to, which, very rightly, they consider

of great importance for the precise knowledge of the physiological effects of alcohol on the human system. As might be expected, this paper describes, exhaustively and at great length, all the experiments made, and the conditions under which they were made. We can only give here a brief *résumé* of the general conclusions arrived at, from which we learn that small quantities of absolute alcohol (1 and 2 fluid ounces = respectively to 28.4 and 56.8 c.c.), given in divided doses to a perfectly healthy man, seemed to increase his appetite; 4 fluid ounces lessened it considerably, and larger quantities almost destroyed it. In other healthy persons, it may be different from the above; while, in most cases of disease, it seems probable that a much smaller amount of alcohol would destroy appetite. The number of beats of the heart in twenty-four hours (as calculated from eight observations made in fourteen hours) increases very largely—viz., an average of more than 13 per cent; while the actual work done by the heart in excess was found to be equal to lifting 15.8 tons 1 foot, and during the two last days of the experiment it did extra work, to the amount of 24 tons lifted as far. These few particulars, all belonging to physiology, may suffice to give a slight idea of the great merits of this paper, from which highly valuable conclusions may be drawn in respect of the use of, and far more the abuse of, ardent spirits. Although these were unknown as beverages some 200 years ago, they are now consumed to such an extent, that, for every man, woman, and child in Scotland, there is consumed annually 10 litres of alcohol, at 59 per cent of absolute alcohol, by bulk, chiefly in the shape of whisky.

## ON A NEW APPARATUS FOR REDUCING CHLORIDE OF SILVER.\*

By A. LEIBIUS, Ph.D.,  
Assayer to the Sydney Branch of the Royal Mint.

IN the refining of gold bullion by Miller's new chlorine process, the silver contained in the alloy thus treated is eliminated from the latter in the state of argentic chloride, which, by a subsequent process, is reduced to metallic silver.

This reduction has always been effected in the usual manner, viz., by placing the slabs of fused argentic chloride between plates of wrought-iron or zinc, with the addition of acidulated water. Although a perfect reduction to metallic silver has always been achieved, yet it required a considerable amount of time and manipulation, since the thick slabs of fused argentic chloride were, after two to three days, only partially converted into metallic silver, and had to be re-arranged in order to expedite their complete reduction. Such manipulations, however, were not only found to be very objectionable on account of the time they required, but more so on account of the very disagreeable work which they caused to the operator. The reduced spongy silver was broken up, by hand, into small pieces, in order to ascertain its complete reduction, and was then boiled in acidulated water to free it from iron or zinc.

It remained, therefore, a desideratum to effect the reduction of the fused masses of argentic chloride in a manner which would, at the same time, be quicker in its execution, and also obviate the just-alluded-to manipulations.

In 1868, Messrs. De la Rue and Hugo Müller, in London, constructed a galvanic battery, one pole of which consisted of fused argentic chloride the thickness of a goose-quill, the other pole of cylinders of zinc. Adopting this principle, I have endeavoured to construct an apparatus which should fulfil the requirements before referred to.

\* Abstract of a paper read before the Royal Society, May, 1870.

\* Read before the Royal Society of Victoria.



After operating successfully with a small model which allows the reduction of about 250 ozs. of argentic chloride in one operation), I have, with slight modifications, constructed an apparatus which will reduce from 1400 to 1500 ozs. of argentic chloride in 24 hours. The apparatus and its dimensions are as follows:—

Two thick boards, 15 inches long, are joined together on both ends by three strong battens, so as to form an open box without a bottom, 13 inches long by 14 inches wide, and 15 inches high (inside measurement). The two boards forming the length of the box or frame contain seven vertical grooves,  $\frac{1}{2}$  inch wide and  $\frac{1}{2}$  inch deep, at intervals of  $1\frac{1}{2}$  inches from each other. These grooves are cut down to a length of 12 inches, leaving 3 inches of each board forming the legs of the frame.

At the termination of these grooves passes horizontally a narrow slit,  $\frac{1}{2}$  inch deep, and along the whole length of each board, into which a strip of metallic silver,  $\frac{1}{2}$  inch wide and the thickness of about a threepenny-piece, is tightly fixed, projecting on one side of the frame about 18 inches beyond each board.

The seven grooves already alluded to are for holding zinc plates,  $\frac{1}{2}$  inch thick, 14 inches long, and 12 inches high, which rest on both sides on the strips of silver, which, as just described, are jammed horizontally into the sides of the two boards. A connection is thus established between the seven zinc plates and these strips of silver.

The second part of the apparatus consists of a wooden frame, cut out of a solid board 1 inch thick, and supplied with two large iron handles. This frame is the same length as the box holding the zinc plates, but 3 inches narrower. It contains on each side, parallel to the direction of the zinc plates, twelve slits  $\frac{1}{2}$  inch long, which hold silver bands  $\frac{1}{2}$  inch broad and the thickness of a threepenny-piece. These silver bands are passed through the slits in the board, so as to form on each side of it six loops,  $11\frac{1}{2}$  inches in length and  $\frac{7}{8}$  inch wide. The six loops on one side are exactly opposite to those on the other side of the board, at a distance of about 9 inches. They are intended to hold the slabs of argentic chloride, which are 12 inches long, 10 inches high, and about  $\frac{3}{4}$  inch thick, and are put through these loops lengthwise, projecting on each end about 1 inch beyond the silver bands.

The whole frame holds, as before stated, six of these slabs of argentic chloride, which are placed between the six spaces formed by the seven zinc plates, from which latter they are about  $\frac{1}{4}$  inch apart on each side.

The projecting horizontal strips of silver jammed into the sides of the lower frame are then connected with the ends of the silver forming the loops in which the argentic chloride is suspended; and the whole apparatus thus charged is placed in a tub filled with water. After a short time, galvanic action is discernible; the liquid gets gradually warmer, and a strong galvanic current is observed. After about 24 hours, the action has nearly ceased, and the whole argentic chloride is found to be completely reduced to metallic silver, which retains in the silver loops the same shape, and, outwardly, also nearly the same appearance as when first introduced as argentic chloride. The latter contains always more or less chloride of copper (eliminated together with the silver during the operation of refining by chlorine), which is reduced together with the chloride of silver; in fact, this soluble chloride of copper helps to act as an exciting liquor for the battery. In the first experiments, a weak solution of salt (chloride of sodium) was used as exciting liquor; but it was found that this could be dispensed with, and only common water used (the action, however, is, in this case, a little retarded and does not become powerful until about two hours after the battery is set). By using a part of the resulting liquor from a previous reduction of argentic chloride, and which contains chloride of zinc, it has been found that the galvanic action sets in very rapidly, and accelerates thereby the completion of the reduction.

No acid is used; and, therefore, the amount of zinc used in each reduction has invariably been found to be almost the theoretical quantity required to combine the chlorine of the argentic chloride treated with the metallic zinc, in order to form chloride of zinc.

The quantity of metallic zinc thus used was always from 24 to 25 per cent of the weight of the argentic chloride reduced.

The reduced silver is boiled out in acidulated water, in order to remove the basic and oxy-chlorides, and finally in pure water, while still suspended in the silver loops. As soon as it is taken off the last boiling, it is immediately ready for the melting-pot, since the heat from the boiling water dries the porous mass of silver sufficiently to allow of its immediate melting. The seven zinc plates, when first used, weigh about 140 lbs. avoirdupois; the six slabs of argentic chloride, of the dimensions already given, weigh about 1400 ozs. troy.

The zinc plates are used over again, until too thin for that purpose, when they are re-melted, and cast into new plates. It has been found that the quantity of zinc used is little, if at all, increased by prolonging the time of connection with the silver plates after the reduction is completed; the whole apparatus, when once set in operation, can therefore be left to itself until it is found convenient to melt the reduced silver.

While this apparatus reduces the argentic chloride much quicker than if the latter is simply placed in contact with zinc or iron plates, it obviates any handling of the argentic chloride from the time the latter has been placed in the silver loops until the reduced silver is ready for the melting-pot;—advantages which have been fully appreciated by those who formerly had to resort to tedious and disagreeable manipulations.

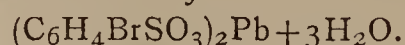
## ON THE SULPHO-ACIDS OF BENZOL.

By A. ROSS GARRICK,  
Balyett, Stranraer, Scotland.

(Concluded from p. 245.)

### SALTS OF ISOSULPHOBROM-BENZOLIC ACID.

#### *Isosulphobrom-benzolate of Lead*—



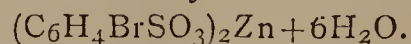
The lead-salt crystallises in small corny crystals. It contains three molecules crystal water, and is more readily soluble in water than the lead-salt of the former acid. It is prepared by neutralising a solution of the acid with lead carbonate.

Water estimation—0.4922 grm. of the salt dried in the air lost, at  $110^\circ$ , 0.0340 grm. = 6.90 per cent  $\text{H}_2\text{O}$ .

Lead estimation—0.4708 grm. of the dry salt gave 0.2120 grm. lead sulphate = 30.76 per cent Pb.

	Calculated.		Found.
$(\text{C}_6\text{H}_4\text{BrSO}_3)_2\text{Pb}$ ..	679	92.64	—
$3\text{H}_2\text{O}$ .. .. .	54	7.36	6.90
	733	100.00	
$(\text{C}_6\text{H}_4\text{BrSO}_3)_2$ ..	472	69.52	—
Pb .. .. .	207	30.48	30.76
	679	100.00	

#### *Isosulphobrom-benzolate of Zinc*—



The zinc-salt, as prepared from the lead-salt by precipitating the lead exactly with a solution of zinc sulphate, forms very indistinct crystals easily soluble in water. It forms a marked contrast to the beautiful crystalline zinc-salt of the former acid.

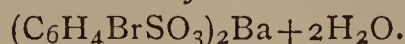


Water estimation—(1) 0.1337 grm. of the salt dried in the air lost, at 110°, 0.0266 grm. = 16.82 per cent H<sub>2</sub>O. (2) 0.2395 grm. of the salt dried in the air lost, at 110°, 0.0397 grm. = 16.57 per cent H<sub>2</sub>O.

Zinc estimation—0.1980 grm. of the dry salt gave, on ignition, 0.0306 grm. = 12.27 per cent Zn.

		Calculated.		Found.	
				I.	II.
(C <sub>6</sub> H <sub>4</sub> BrSO <sub>3</sub> ) <sub>2</sub> Zn	..	537.2	83.27	—	—
6H <sub>2</sub> O	.. ..	108.0	16.73	16.82	16.57
		645.2	100.00		
(C <sub>6</sub> H <sub>4</sub> BrSO <sub>3</sub> ) <sub>2</sub>	.. ..	472.0	87.89	—	—
Zn	.. ..	65.2	12.11	12.27	
		537.2	100.00		

*Isosulphobrom-benzolate of Barium—*



The barium-salt differs entirely from the barium-salt of the former acid. It crystallises in radiated fibres containing two molecules crystal water. The barium-salt of former acid forms splendid leaflets of a silver glance.

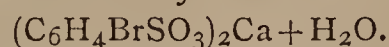
By neutralising a solution of the acid with barium carbonate, filtering, and evaporating, this salt is obtained.

Water estimation—0.3791 grm. of the salt dried in the air lost, at 110°, 0.0203 grm. = 5.32 per cent H<sub>2</sub>O.

Barium estimation—0.3555 grm. of the dry salt gave, on ignition, 0.1358 grm. barium sulphate = 22.45 per cent Ba.

		Calculated.		Found.
(C <sub>6</sub> H <sub>4</sub> BrSO <sub>3</sub> ) <sub>2</sub> Ba	..	609	94.39	—
2H <sub>2</sub> O	.. ..	36	5.61	5.32
		645	100.00	
(C <sub>6</sub> H <sub>4</sub> BrSO <sub>3</sub> ) <sub>2</sub>	..	472	77.51	—
Ba	.. ..	137	22.49	22.45
		609	100.00	

*Isosulphobrom-benzolate of Calcium—*



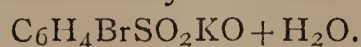
The calcium-salt forms small colourless crystals closely grouped together, which are easily soluble in water. It remains unchanged on exposure to the air, whereas the calcium-salt of the former acid is efflorescent and crystallises in large monoclinic prisms. It is prepared by neutralising a solution of the acid with calcium carbonate.

Water estimation—0.02365 grm. of the salt dried in the air lost, at 110°, 0.0088 grm. = 3.72 per cent H<sub>2</sub>O.

Calcium estimation—0.2300 grm. of the dry salt gave 0.0602 grm. calcium sulphate = 7.65 per cent Ca.

		Calculated.		Found.
(C <sub>6</sub> H <sub>4</sub> BrSO <sub>3</sub> ) <sub>2</sub> Ca	..	512	96.60	—
H <sub>2</sub> O	.. ..	18	3.40	3.72
		530	100.00	
(C <sub>6</sub> H <sub>4</sub> BrSO <sub>3</sub> ) <sub>2</sub>	..	472	92.58	—
Ca	.. ..	40	7.42	7.65
		512	100.00	

*Isosulphobrom-benzolate of Potassium—*



The potassium-salt is exceedingly soluble in water. It crystallises in star-shaped groups containing water of crystallisation. The potassium-salt of the former acid forms large distinct rhombic plates, and is less soluble in water than this salt.

It is prepared from a solution of the barium-salt by precipitating the barium exactly with potassium sulphate.

Water estimation—0.2298 grm. of the salt dried in the air lost, at 110°, 0.0085 grm. = 3.69 per cent H<sub>2</sub>O.

Potassium estimation—0.2620 grm. of the dry salt gave 0.0868 grm. potassium sulphate = 14.53 per cent K.

		Calculated.		Found.
C <sub>6</sub> H <sub>4</sub> BrSO <sub>2</sub> KO	..	275.11	96.83	—
½H <sub>2</sub> O	.. ..	9.00	3.17	3.69
		284.11	100.00	
C <sub>6</sub> H <sub>4</sub> BrSO <sub>3</sub>	.. ..	236.00	85.79	—
K	.. ..	39.11	14.21	14.53
		275.11	100.00	

If we examine the characteristics of the two acids which, with their salts, have just been described, we cannot doubt but that we have to do with two entirely distinct bodies. Each salt of one acid differs very strikingly from the corresponding one of the other acid—no two analogous salts possess the least degree of resemblance with each other. In addition to this, the sulphobrom-benzolic acid first prepared is much less deliquescent than the following isomeric acid; the fusing-point could be with ease determined, and was found exactly at 88°. The isosulphobrom-benzolic acid, on the other hand, becomes liquid almost instantaneously on coming in contact with the air, so that all attempts at determining the fusing-point were entirely fruitless.

The physical properties compel us, then, to consider the two acids as isomeric, and not identical. Other means for characterising the two we do not possess, but circumstances cannot possibly work such differences in one and the same body as we observe between these two acids and the salts derived from them.

In the preparation of isosulphobrom-benzolic acid, after acting on sulphobenzolic acid with bromine in a sealed tube, the residue was dissolved in water and evaporated on the water-bath until freed from hydrobromic acid. On attempting to dissolve the residue, a substance separated, leaving the acid in solution. This was then separated by filtration, dissolved in alcohol, and, by allowing the solution to stand, needle-shaped crystals were obtained. It seemed probable that the crystals were those of tetrabrombenzol; and, on making an estimation of the amount of bromine, results were obtained agreeing pretty closely with the theoretical percentage of bromine contained in that compound. The small amount of substance at command rendered it impossible to make an estimation of the other constituents, or to control the estimation of bromine made.

Bromine estimation—0.1063 grm. of the substance gave 0.2007 grm. silver bromide = 80.33 per cent Br.

		Calculated for tetrabrombenzol, C <sub>6</sub> H <sub>2</sub> Br <sub>4</sub> .		Found.
Carbon	.. ..	72	18.28	—
Hydrogen	.. ..	2	0.51	—
Bromine	.. ..	320	81.21	80.33
		394	100.00	

ON THE PREPARATION OF THE ISOMERIC DIATOMIC PHENOLS FROM THE SULPHO-ACIDS OF BENZOL.

The principal object of scientific chemistry at the present day is not the simple discovery of new chemical individuals. Although they are constantly appearing in all researches in the field of science, still they merely aid the investigator in simplifying, in systematising known facts. He accepts certain theories as a foundation for his researches; and, while he acknowledges the possibility that these accepted theories may be false, he nevertheless works on the assumption that they are true. If new facts brought forward by him present no points which speak against the theories, he has no right to disbelieve them—at



all events, not the right of experience. He must, on the contrary, if possible, show in what relation his researches stand to the ruling theories. If he then succeeds in proving the true position of but one substance, he has accomplished something towards the one grand end of the science—classification.

All the derivatives of benzol in which two hydrogen atoms are replaced by other univalent groups have been divided into three series, called, respectively, the ortho, para, and meta series. Of each derivative, there exists three isomeric varieties, corresponding to the three series. The difference between the three varieties arises from a difference in the arrangement in the substituting radicals in the molecule.

In consequence of characteristic reactions and methods of formation, the three isomeric diatomic phenols or hydroxyle derivatives of benzol have been placed as follows:—

Ortho series.	Para series.	Meta series.
Hydroquinone.	Resorcin.	Pyrocatechin.

We are, however, in possession of an elegant method for the formation of these phenols from the sulpho-acids. This is the method described by Kekulé, Würtz, and Dusart. It consists in fusing, at a high temperature, the potassium-salts of the sulpho-acids with potassium hydrate. By this means, the potassium hydrate acts upon the group  $\text{SO}_2\text{HO}$ , forming potassium sulphite and hydroxyle, which latter remains in the benzol molecule. The same thing takes place if one hydrogen is replaced by bromine or chlorine, with the difference, of course, that bromide or chloride of potassium are formed.

By applying this method to the acids above described, I have been enabled to show to which of the three groups they each belong.

*Preparation of Resorcin,  $\text{C}_6\text{H}_4\left\{\begin{smallmatrix} \text{HO} \\ \text{HO} \end{smallmatrix}\right\}$ , from Disulphobenzolic Acid.*

It was highly probable that, by adopting the method of Kekulé, Würtz, and Dusart, one of the three isomeric phenols (hydroquinone, resorcin, pyrocatechin) could be prepared from disulphobenzolic acid.

For this purpose, the potassium-salt of this acid was fused with three times its weight of potassium hydrate at a temperature of about  $230^\circ$  for two hours. The reaction proceeds as follows:—



The fused mass was then dissolved in water, acidified with dilute sulphuric acid, shaken up two or three times with ether, and the ethereal solution distilled on the water-bath. On concentrating the residue by evaporation, the solution separated out into distinct crystals. The crystals, which were of a dark colour, were allowed to stand over sulphuric acid, and then subjected to distillation, and the distillate collected between  $270^\circ$  and  $280^\circ$ .

The substance was subjected to analysis after standing for some time over sulphuric acid.

0.2662 grm. of the substance on combustion with cupric oxide, gave 0.6377 grm. carbonic acid = 65.32 per cent C.

0.2662 grm. gave 0.1365 grm. water = 5.69 per cent H.

	Calculated for $\text{C}_6\text{H}_4\text{O}_2$ .	Found.
Carbon .. ..	65.45 .. ..	65.32
Hydrogen .. ..	5.45 .. ..	5.69
Oxygen .. ..	29.10 .. ..	—
	100.00	

These results correspond to the formula  $\text{C}_6\text{H}_4\text{O}_2$ .

The substance, even in the pure condition, retained the smell of the phenols, and was soluble in water, alcohol, and ether. It melted exactly at  $104^\circ$ , which corresponds to the melting-point of resorcin given by Oppenheim and Vogt (*Ann. Chem. Pharm.*, Suppl., vol. vi., 376).

Its boiling-point agrees with that of resorcin, whereas

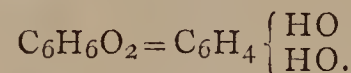
at the temperature at which it was distilled hydroquinone is not decomposed and pyrocatechin boils at  $245^\circ$ .

The fact that its solution became of a dark violet colour on the addition of a solution of ferric chloride, proved farther, without doubt, that the body so prepared was resorcin.

Adopting the method of Kekulé, Würtz, and Dusart, Oppenheim and Vogt (*Ann. Chem. Pharm.*, Suppl., vol. vi., p. 376) succeeded in preparing resorcin from sulphochlorbenzolic acid. For this purpose, they first prepared monochlorbenzol by the method recommended by Müller—viz., dissolving iodine in benzol, and for several hours conducting chlorine into the solution. The product was then subjected to fractional distillation, and the distillate collected from  $130^\circ$  to  $140^\circ$ . They then heated the monochlorbenzol so prepared with a little more than an equivalent of sulphuric acid. The crude acid was then dissolved in water, and freed from excess of sulphuric acid by treating it with barium carbonate. The barium was then precipitated with potassium carbonate, and the solution evaporated. The sulphochlorbenzolate of potassium so obtained was then fused with potassium hydrate in different proportions. In an experiment tried by fusing this salt with only a small proportion of potassium hydrate, dissolving the fused mass in water, neutralising with hydrochloric acid, and then shaking up with ether, they obtained a product containing chlorine.

By, however, employing a larger proportion of potassium hydrate, the red colour which was produced in the previous experiment was entirely destroyed; and, on neutralising the fused mass with hydrochloric acid, after dissolving the mass in water, and shaking up with ether, a solution was obtained free from chlorine. From this solution, they obtained, by spontaneous evaporation, crystals of a columnar or plate form, which were purified by subjecting them to distillation.

By analysis, they proved the substance to correspond to the formula of—



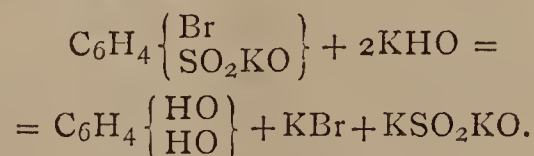
The crystals they describe as retaining the odour of phenol, having a sweet taste, and being soluble in water, alcohol, and ether.

The melting-point they found to be  $104^\circ$ , being  $3^\circ$  higher than the melting-point of resorcin as given by Hlasiwetz and Barth (*Ann. Chem. Pharm.*, vol. cxli., p. 224).

*Preparation of Resorcin,  $\text{C}_6\text{H}_4\text{O}_2 = \text{C}_6\text{H}_4\left\{\begin{smallmatrix} \text{HO} \\ \text{HO} \end{smallmatrix}\right\}$ , from Sulphobrombenzolic Acid.*

The fact that the sulphobrombenzolic acid was prepared in a manner analogous to that adopted in the preparation of the sulphochlorbenzolic acid, made it appear highly probable that it would also yield resorcin by applying the same method for introducing the hydroxyle groups.

Sulphobrombenzolate of potassium was accordingly fused with three times its weight of potassium hydrate at a temperature of about  $275^\circ$  for two hours. The reaction proceeds as follows:—



The fused mass was then dissolved in water, acidified with dilute sulphuric acid, and shaken up with ether. The ethereal solution was distilled on the water-bath, the residue concentrated by evaporation, and distilled. The substance so produced was exceedingly soluble in water, alcohol, and ether. On exposure to the air, it became rapidly of a reddish colour. The fact, also, that it became of a dark violet colour on the addition of a solution of ferric chloride furnished sufficient proof of the identity of the substance prepared with resorcin.



Preparation of Hydroquinone,  $C_6H_6O_2 = C_6H_4 \begin{cases} HO \\ HO, \end{cases}$   
from Isosulphobrom-benzolic Acid.

That in the same way one of the two remaining isomeric phenols (hydroquinone, pyrocatechin), could be prepared from isosulphobrom-benzolic acid, was in the highest degree probable.

Adopting the same method, isosulphobrom-benzolate of potassium was fused with three times its weight of potassium hydrate, at a temperature of about  $275^\circ$ , for two hours; the residue dissolved in water, acidified with dilute sulphuric acid and shaken up with ether. The ethereal solution was then distilled on the water-bath.

It now remained to be determined which of the two isomeric compounds was produced. Advantage was taken of the property of pyrocatechin to form, on the addition of lead acetate, a compound insoluble in water, whereas the hydroquinone remains in solution. By obtaining no precipitate on the addition of lead acetate, satisfactory proof was given of the absence of pyrocatechin. The solution was then decomposed with hydrosulphuric acid, filtered, and concentrated by evaporation on the water-bath.

On the addition of ferric chloride to a solution of the substance, a green precipitate was produced = quinhydrone, or green hydroquinone,  $C_{12}H_{10}O_4$ . On boiling this solution, this substance was decomposed, the characteristic odour of quinone was produced, and a brown material remained behind.

These reactions render it highly probable that by this process hydroquinone is produced. Certain it is that no pyrocatechin is produced, as this must have been precipitated by the addition of lead acetate to a solution containing it, whereas, as we have seen, no precipitate separated. Not a single reaction could give rise to a suspicion that the substance was resorcin. Unfortunately, the small quantity of substance at command did not suffice to answer the question, beyond a doubt, whether the substance produced was hydroquinone or not. As, however, the negative proof—viz., that it was neither pyrocatechin nor resorcin—is well established, we are justified in concluding that hydroquinone was produced.

As a result of these experiments, we can then draw the following conclusions:—

1st. In disulphobenzolic acid, sulphochlor-benzolic acid, and sulphobrom-benzolic acid, the substituting radicals have the same relative position to each other; and this is the same as that which exists between the hydroxyle groups in resorcin. This shows them to belong to the para series.

2nd. Isosulphobrom-benzolic acid belongs to the ortho series, the  $SO_2HO$  and Br standing to each other in the same relation that HO and HO stand to each other in hydroquinone.

Ortho series.	Para series.	Meta series.
Isosulphobrom-benzolic acid.	Sulphochlor-benzolic acid.	—
—	Sulphobrom-benzolic acid.	—
—	Disulphobenzolic acid.	—

A

# LABORATORY OF EXPERIMENTAL RESEARCH.\*

By Prof. ALBERT R. LEEDS.

ONE of the most important services rendered by the great Swedish chemist to his beloved science was that he freed it from its previously-attendant mystery and discomfort—its dirt and gloom. The cold outbuildings and damp stone floors, hitherto thought proper for destructive acids and noxious vapours and dangerous furnace-fires, were

\* Communicated by Prof. Morton.

too unwholesome to be endured through the protracted severities of a Swedish winter; and so Berzelius carried his crucibles into comfortable rooms in his own dwelling, made the clumsy furnace yield to his convenient lamp, and made chemistry a science most cheerful and domestic. Among the young chemists who were attracted, by the splendour of his discoveries, to the home of Berzelius was Henry Rose. When, later in life, Rose became Professor of Chemistry in the University of Berlin, he also devoted two or three small rooms in his own house, and admitted to them a few students, who came, highly recommended for their skill and chemical knowledge, to work out analytical methods under his direction. Among them, and for several years his assistant, was Dr. Finkener, recently appointed Professor at the Berg Schule in Berlin. This Berg Schule occupies the Old Bourse, and the chemical laboratory is the large hall in which the bankers of Berlin were wont to assemble before their present magnificent Bourse upon the opposite side of the Spree was erected. The assiduity, care, and ingenuity which Dr. Finkener has displayed in the last, the sixth, and in former editions of Rose's great work on Analytical Chemistry, has given him a familiarity with analytical processes which has rendered him deservedly successful and popular as a teacher. To an American, the fees in the Institution appear incredibly small. For the daily use of the laboratory for five months, including gas, chemicals, and apparatus, the charge is 20 thalers (about 20 dollars in currency at the present time). Nor is this economy obtained at the sacrifice of those facilities which the student may reasonably expect in the present advanced state of chemical science. One or two agate mortars, a couple of steel mortars, the cork-borers, files, and other simple tools, the sand and water baths, &c., are the property and for the use of all. The students enforce the police regulations, and keep the laboratory in order. The apparatus for the evolution of sulphuretted hydrogen, carbonic acid, and hydrogen is arranged by an assistant; and the time of the student is not consumed in preparing these contrivances for himself: the same remark applies to the apparatus for the manufacture of chlorine, hydrofluoric acid, the determination of carbonic acid, nitrogen, &c.; to the burettes and standard solutions for volumetric analysis. In desk-room the student is limited, though not hampered for want of space. Of hood-room there is more than sufficient for all the evaporations and operations detrimental to health which the students are likely at any one time to be carrying on. How different from one of the largest of our American laboratories, where the regular charges are 100 dollars per term, and the incidental amount to a very considerable sum. Each student is required to consume time and money in constructing a sulphuretted hydrogen, carbonic, hydrogen, and other apparatus for himself; and, without he consumes more of both than most can afford, his apparatus, when completed, is inadequate to accomplish nice work or obtain accurate results. In respect to size and completeness, the laboratory of the Berg Schule at Berlin is much superior to that of the Mining School at Freiburg, now, and for many years past, under the direction of Professor Scheerer: the rooms are small, dark, and ill-provided with gas and apparatus.

Since the calamities which have fallen upon the kingdom of Saxony, the places of such as Breithaupt and his illustrious co-labourers have not been filled by men of equal renown; and the ancient glory of the Institution is departing. The student still goes to see the great cabinet of minerals accumulated by the father of Geology and his successor, and still may obtain excellent practical instruction in the determination of minerals. Here, as at some other places in Europe, and in our own country, where mineralogy is successfully taught, fragments of crystals are put into the hands of students, and they are expected, under the eye of the teacher, to determine their hardness, cleavage, and crystalline form. Their attention is directed to the peculiarities of surface condition, optical properties, &c.; and they are taught to substitute critical examination



for slovenly guess-work. The fiery enthusiasm with which the old Professor of Metallurgy performs his duties still attracts students, who have finished their studies at other schools, to Freiburg for this special course; and nothing certainly can be more gratifying than the zeal with which the lynx eyes of the Professor follow the assay from the incipient stages of its preparation, through the blazing furnace, to the triumphant moment when the button emerges into view. The metallurgical apartment at the Ecole des Mines in Paris is more imposing in appearance: with its practical working I am not so well acquainted. The Free Laboratory in the Jardin des Plantes is adapted only to elementary work; that at the Ecole Centrale is dirty and dismal; and that of the Sorbonne, which was erected at about the same time as the great Frederick Wilhelm Laboratories at Bonn and Berlin, is not comparable to either in size, elegance, and completeness. In the latter of these two noble edifices, the beautiful lecture-room is provided with a special laboratory for the preparation of lecture experiments, and also a museum of such minerals, apparatus, models, and metallurgical and industrial products as are useful in demonstration or illustration. Between the spacious apartments for qualitative and quantitative analysis, there is a room devoted to the preparation of reagents. There are also separate apartments set aside for metallurgic and pharmaceutical processes, weighing-rooms, a library, a room for organic analysis, and one for students engaged in original investigation.

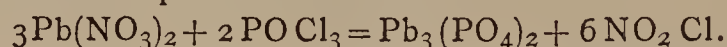
There is no provision, however, for the prosecution of researches in physics, and but scanty accommodations to workers in physiology. Prof. Magnus, of the University of Berlin, has devoted a few rooms in his dwelling to physical research; and, while I was engaged there, three other students were present, one occupied by an investigation in acoustics, another in polarised light, and a third in the measurement of crystals of recently-discovered chemical compounds. A laboratory of physics is greatly needed at the present time in our own country. The teachers of natural philosophy in our colleges have little opportunity for fitting themselves by a course of special training for their duties, and are seldom able to make or improve their apparatus, or to enter with success into experimental research. A chemist is able to effect little who has not acquired, by years of practice, skill in the conduct of analyses. So, too, other things being equal, he will be the most successful physicist who is the best mechanic. In such an institution, the mechanical ought to advance with the mathematical education; and, while the pupil is studying mensuration, he might be mastering the turning-lathe; and, while applying calculus to optics, in grinding and mounting a lens. We do not advocate such an education only for those who design to be physicists by profession, but regard it as best adapted to develop many minds, and to bring forth a kind of talent eminently useful. Where shall the civil engineer, the miner, or the architect get such an education at present? Yet, to all these men, the ability to construct, as well as to plan a house, machine, or engine would be of inestimable value. Moreover, a long course of theoretical instruction alone is dry, and oftentimes disheartening, especially to those who, with great native ingenuity and mechanical skill, have little facility in mathematics. Such a physical laboratory should have a carpenter's shop, with tools for all kinds of joinery and turning; a machine-room, with furnace, bellows, anvils, vices, lathes, &c., and a room for finishing apparatus and the nicer kinds of work. Under the conduct of skilled mechanics, the students might be taught to make the apparatus requisite to demonstrate the principles of natural philosophy; and, when they were prepared to undertake researches of their own, or to take their degrees as engineers, they would be able to cope with the practical matters which would occupy their time and energies. Besides the workshops, there should be separate rooms in a laboratory of this description, devoted to researches in heat and optics, including spectrum analysis, photometry, micro-

scopy, and crystallography; to acoustics, electricity, and magnetism, and to the problems of engineering. We believe that there are many young men to whom an education of this kind would prove more attractive than any now obtainable, and that the practicable benefits, as well as the scientific results of such an institution would be very great.—*Journal of the Franklin Institute.*

## ON THE CHEMICAL ACTIVITY OF NITRATES.\*

By EDMUND J. MILLS, D.Sc.

IN the course of his researches upon nitro-compounds, the author found it extremely desirable to submit the genetic relations of those bodies to a detailed examination; in other words, to trace the modifications undergone by nitryl as it is transmitted (from the chloride, hydrate, or free radical) through an adequate succession of combinations. One of the first steps in this direction is the preparation of nitrylic chloride, which can be most easily effected, according to a statement in Watts's "Dictionary of Chemistry,"† by the action of phosphoric oxychloride on plumbic nitrate—



Among other modes of verifying this equation, the examination of the residue left behind when excess of the oxychloride is heated with plumbic nitrate, and then distilled off in a current of dry air, appeared the most simple and obvious. The results were found not to agree with the equation; and after three nitrates had been tried, a law of chemical activity became evident, rendering the reaction worthy of pursuit for its own sake, although, as an available source of nitrylic chloride, it had failed entirely. The nature and mode of establishment of this law constitute the subjects of the author's memoir.

When a nitrate is treated with phosphoric oxychloride, as has just been mentioned, the residue contains phosphoric oxide and a metallic chloride. Within the limits of experimental error, or subject to other satisfactory explanation, the ratio between these two products is constant for each nitrate; and from that ratio a quotient  $\alpha$  can be found as follows:—

$$\begin{aligned} \alpha &= \frac{\text{weight of chlorine}}{\text{weight of phosphoric oxide}} = \frac{\text{Cl}}{\text{P}_2\text{O}_5} \\ &= \frac{\text{weight of chlorine}}{\text{weight of phosphoric oxide}} \times 4.06 \end{aligned}$$

This quotient, which is different for each nitrate, is termed the "coefficient of chemical activity" of nitrates, and the method of obtaining it is designated the "method of ratios." The data from which  $\alpha$  is deduced, namely, certain weights of argentic chloride and magnesian pyrophosphate, are, if singly considered, new with each experiment; they depend on time, rate of heating, the state of division of the nitrate, and other conditions. But, assuming the results to have been brought about under a law of chemical action, the values of  $\alpha$  must be independent of those circumstances, by which the primitive numerator and denominator could have been only *pari passu* affected; they are related only to the actual occurrence of the reaction. This property, in a chemical ratio, has not, it is believed, been previously observed.

After describing the means employed for obtaining a current of dry air, the apparatus required for the reaction,

\* Abstract of a paper read before the Royal Society, May 19, 1870.

† Vol. iv., p. 77.



and the individual experiments which were severally made, the following table of results is given,  $\Sigma$  being the symbolic value of a nitrate, and  $Q = \frac{\Sigma}{a}$ .

			$a$	$\Sigma$	$Q$
{	Thallous nitrate	.. ..	8.76	265.30	30.29
{	Argentio nitrate	.. ..	5.48	169.94	31.01
{	Plumbic nitrate	.. ..	5.17	165.56	32.02
	Rubidic nitrate	.. ..	2.38	147.40	61.93
	Cæsic nitrate	.. ..	2.21	195.01	88.24
{	Potassic nitrate	.. ..	1.99	101.14	50.82
{	Sodic nitrate	.. ..	1.70	85.05	50.03
	Lithic nitrate	.. ..	1.61	69.00	42.86

The above list probably contains all the metallic nitrates that can be completely dried, excepting nitrates derived from amines and amides, which in the present state of our knowledge of the phosphamides, it was evidently advisable to exclude.

In the silver group, the mean value of  $Q$  is 31.11; and the following equation may be accepted therefor:—

$$a = \frac{\Sigma}{31.11}$$

In the potassium group we have likewise

$$a = \frac{\Sigma}{50.42}$$

Hence, within each set of nitrates, chemical activity is in direct proportion to symbolic value. It is further sufficiently apparent that (excepting subidic nitrate)  $a$  and  $\Sigma$  increase and diminish in the same general order. Within the limits of error, the  $Q$  column is an incomplete arithmetical series, the most probable value of whose first term is 6.258, so that

$$Q = m \cdot 6.258,$$

$m$  being integral. Reasons are then adduced for identifying the number 6.25 with Dulong and Petit's constant of specific heat. Moreover, since the product of specific heat and symbolic value is, generally,  $n \cdot 6.25$ , and  $m$  is greater than  $n$ , taking  $m = xn$  and  $s =$  the specific heat of a nitrate, we have

$$\begin{aligned} Q &= xn \cdot 6.25, \\ \text{but } \Sigma s &= n \cdot 6.25; \\ \therefore Q &= x \Sigma s, \end{aligned}$$

$$\text{and } a = \frac{\Sigma}{Q} = \frac{\Sigma}{x \Sigma s} = \frac{1}{xs}$$

the expression for chemical activity in terms of specific heat. Comparing the coefficients ( $a, a'$ ) for any two nitrates, the following relations are obtained:—

$$\frac{a}{a'} = \frac{m'}{m} \cdot \frac{\Sigma}{\Sigma'} = \frac{x' s'}{xs};$$

and it is shown that these formulæ agree sufficiently well with experiment. Where  $m = m'$  and  $x = x'$ , we have the simple expression—

$$\frac{a}{a'} = \frac{\Sigma}{\Sigma'} = \frac{s'}{s}$$

The values of  $Q$  are strictly equivalent to each other in point of activity. The author believes that  $a$  is commensurate with the elective function of chemical attraction, first discovered by Bergman. He terminates the memoir with a reference to some well-known instances of chemical action (such as that of argentic nitrate on a mixture of aqueous potassic chloride, bromide, and iodide), as serving to bestow a presumptive generality on his principal conclusions.

## PROCEEDINGS OF SOCIETIES.

### ROYAL INSTITUTION OF GREAT BRITAIN.

*Notes of a Course of Seven Lectures on Electrical Phenomena and Theories.* By Professor TYNDALL, LL.D., F.R.S. (Lecture III.)

63. By the friction of a woollen cloth, amber is endowed with the power of attracting light bodies. This substance was called *Electron* by the Greeks; hence the name *Electricity* was applied to the power of attraction exhibited by amber. This attraction remained an isolated fact for more than 2000 years.

64. In the year 1600, Dr. Gilbert, of Colchester, physician to Queen Elizabeth, showed that the power of attraction was shared by many other substances. Dry glass, for example, when rubbed by silk, and dry sealing-wax when rubbed by flannel, exhibit this attractive power: when they do so, they are said to be *electrified*.

65. An electrified body attracts and is attracted by all kinds of unelectrified matter; but *repulsion* may also come into play. Thus, rubbed glass *repels* rubbed glass, and rubbed sealing-wax *repels* rubbed sealing-wax; while rubbed glass attracts rubbed sealing-wax, and rubbed sealing-wax attracts rubbed glass.

66. Hence the notion of *two kinds* of electricity, one proper to vitreous bodies, and therefore called vitreous electricity; the other proper to resinous bodies, and therefore called resinous electricity.

67. These terms are improper, because, by employing suitable rubbers, we can obtain the electricity of sealing-wax from glass, and the electricity of glass from sealing-wax. We now use the term *positive* electricity to denote that developed on glass by the friction of silk; and *negative* electricity to denote that developed on sealing-wax by the friction of flannel.

68. Bodies endowed with the same electricity repel each other; while bodies endowed with opposite electricities attract each other. This is the fundamental law of electric action.

69. The rubber and the body rubbed are always endowed with opposite electricities. They always attract each other. The work done in overcoming this attraction appears as heat in the electric spark.

70. To find the kind of electricity with which a body is endowed, we must ascertain, by trial, the electricity by which the body is *repelled*; this, we may be sure, is the electricity of the body. *Attraction* does not furnish a safe test, because unelectrified bodies are attracted.

71. Some substances possess, in a very high degree, the capacity of transmitting the electric power, or condition; others possess, in a high degree, the capacity of intercepting it. The former bodies are called *conductors*, the latter bodies *insulators*.

72. The insulators were formerly called *electrics*, because they could be electrified by friction *when held in the hand*; the conductors were called *non-electrics*, because they could not be so electrified. The division is improper; because, if a conductor be insulated, it can readily be electrified. To keep it electrified, an insulator must be introduced between it and the earth.

73. What is electricity? Why should it adhere so tenaciously to some substances, and flow so freely through or along others? The human mind has made many attempts to imagine the inner cause of electric action, and it still continues to make such attempts. Formerly, it was thought that magnetism and electricity, as well as light and heat, were all the work of "imponderable matter," associated with the ordinary matter. In the case of light and heat, this conception has undergone profound modification, and we seem to see clearly the mechanical cause of both. But no similar clearness has as yet been attained with regard to electricity, though a strong presumption exists that our notions of it are destined soon to undergo a modification equally profound.



74. Meanwhile, we may employ the provisional conception furnished by the *theory of electric fluids*: it will enable us to classify our facts.

75. According to this theory, electrical attractions and repulsions arise from two invisible fluids, each self-repulsive, but both mutually attractive. The fluids are supposed to be mixed together, to form a compound neutral fluid in unelectrified bodies.

76. The act of electrification by friction consists in the forcible separation of the two fluids, one of which is diffused over the rubber, and the other over the body rubbed; but they may also be separated in another way, now to be illustrated.

77. If an electrified body be brought near an insulated, unelectrified conductor, but not into contact with it, the electrified body will decompose the compound fluid of the conductor, attracting one of its constituents and repelling the other. When the electrified body is withdrawn, the separated fluids re-unite and neutralise each other.

78. This forcible separation of the two fluids of a neutral conductor by the mere proximity of an electrified body is called *electric induction*. Bodies in this state are also said to be electrified by *influence*. Neutral bodies are attracted because they are first excited by induction.

79. When an insulated conductor is acted on by an electrified body, its repelled electricity is free, but its attracted electricity is held captive by the inducing electrified body. Connecting the conductor for a moment with the earth, its free electricity escapes; and then, on the removal of the electrified inducing body, the captive electricity is liberated, and diffused over the surface of the conductor.

80. Thus, by the mere proximity of the electrified body, and without establishing contact between it and the neutral conductor, we can charge the latter *with the opposite electricity*.

81. Two sheets of tin-foil (conductors) being separated from each other by a sheet of glass (an insulator), if one sheet have electricity imparted to it, it will act through the glass, and decompose the neutral electricity of the opposite sheet, attracting the one constituent and repelling the other.

82. If the second sheet be connected with the earth, the repelled electricity will flow away, and we shall have two mutually-attractive layers of electricity separated from each other by the glass.

83. If the one sheet of tin-foil be united with the other by a conductor, the two opposite electricities will flow together: the tin-foil is then said to be discharged. This discharge usually assumes the form of a spark.

84. If the surface of a cake of resin, or of a sheet of vulcanised india-rubber, be electrified, a plate of metal laid upon it will have its neutral fluid decomposed, its positive fluid being attracted and its negative repelled. On touching the metal plate, its free (repelled) electricity flows to the earth; and now, if the plate be raised by an insulating-handle, it will appear charged with positive electricity. This is the principle of the *Electrophorus*.

85. An electric machine consists of two parts; the insulator, which is excited by friction, and the prime conductor.

86. The first electric machine consisted of a ball of sulphur, which was rubbed against the hand. It was invented by Otto Von Guericke, Burgomaster of Magdeburg, in the year 1671. A sphere of glass was afterwards introduced, then a cylinder of glass, and finally a round glass plate, which was rubbed with dry silk.

87. The prime conductor is thus charged:—When the glass plate is turned by a handle, it passes between the silk rubbers, and is positively electrified. The electrified glass then acts by induction upon the prime conductor, attracting the negative electricity and repelling its positive. The conductor is furnished with points, from which the negative electricity streams out against the excited glass. Thus the prime conductor is charged, not by directly

communicating to it positive electricity, but by robbing it of its negative, the positive remaining behind.

88. The arrangement mentioned in Note 81 is virtually a Leyden-jar. Were the plate of glass there referred to moulded into the shape of a jar, one sheet of foil would cover its interior and the other its exterior. When the jar is connected with an electric machine, its charged interior coating acts by induction across the glass on the exterior coating, attracting the opposite and repelling the similar electricity.

89. In the experiment which led to the discovery of the Leyden-jar, *the hand of the experimentalist* served as the outer coating.

90. The escape of the repelled electricity of the outer coating to the earth leaves the captive electricity exposed solely to the attraction of that within the jar, and enables the jar to take a strong charge.

91. When the outer and the inner coatings are connected by a conductor, *an electric current* passes from the one to the other.

92. The current starts at the same instant from the inner and outer coatings, the *middle* point of the conductor being reached last by the current. This indicates that there are *two* currents, which start at the same moment from the inner and outer coatings.

93. It is agreed to call the direction in which the *positive* electricity flows *the direction of the current*.

94. When an electric current encounters resistance in its passage, heat is developed. This heat is sometimes so intense as to reduce metals to a state of vapour.

95. When a body is intensely electrified, it will discharge its electricity to an unelectrified body across an interval of air, in the form of an electric spark. Two bodies, oppositely electrified, discharge to each other in the same way.

96. When two oppositely-electrified clouds discharge towards each other, the track of the lightning marks the course of an electric current, and the sound of the thunder is the sound of an electric spark.

97. An electrified cloud, if it come near the earth, may discharge its electricity to the earth in the same way.

98. If the body through which the atmospheric electricity passes be a good conductor, and of sufficient size, no harm is done; but the *resistance* offered by trees, houses, and animals to the passage of the electricity usually causes their destruction.

99. The nervous system requires a certain interval of time to become conscious of pain. The time of an electric discharge is but a small fraction of this interval; hence, as a sentient apparatus, the nervous system is destroyed before consciousness can set in. If this be true (and there are the strongest grounds for believing it to be true), death from lightning must be painless.

100. When an electrified cloud passes over a pointed lightning-conductor, the opposite electricity of the earth is discharged from the point of the conductor against the cloud. The cloud is thus neutralised, and, in general, without producing thunder.

101. The duration of an electric spark amounts only to an extremely small fraction of a second. On this account, when moving bodies are suddenly illuminated by the spark from a Leyden-jar, they appear to *rest* for a short interval in the position which they occupied when the flash fell upon them. A moving cannon-ball, illuminated by a flash of lightning, appears to stand still for about one-eighth of a second, this being about the interval during which an impression, once made, persists upon the retina.

102. The unretarded electric spark will scatter gun-powder, but will not ignite it. To produce ignition, it is necessary to retard the discharge by sending it through a wet string.

103. If we double the quantity of electricity imparted to the same conductor, the density of the electricity is said to be doubled; if we treble the quantity, the density is said to be trebled, and so on.



104. On a *sphere*, the density of the electricity is the same at all points of its surface; on a *plate*, the density is greatest at the edges; and, on an elongated conductor, the density is greatest at the ends.

105. When the conductor ends in a sharp point, the electric density at the point is so great that the electricity discharges itself into the air.

106. The air thus electrified is self-repellent, and is also repelled by the point, the so-called "electric wind" being produced.

107. By causing an electric wind to issue from opposite points of a light body, the reaction of the two winds may make the body to float in stable equilibrium in the air.

108. The outer ends of two pieces of zinc and platinum, partially immersed in acidulated water, are in opposite electrical conditions. The free platinum-end shows positive electricity, while the free zinc-end shows negative electricity.

109. When both plates are united by a wire, the positive flows along the wire towards the negative, and the negative towards the positive; but, as mentioned in Note 93, it is agreed to call the direction in which the positive electricity flows *the direction of the current*.

110. The force which urges this current forward (the electromotive force) is enormously less than that which urges forward a current of frictional electricity. The consequence is that the latter is able to surmount resistances which are totally insurmountable by the former.

111. But, by linking cells together, we cause the voltaic current to approach more and more to the character of the frictional current. It requires, however, a battery of more than a thousand cells to make the current from a voltaic battery jump over an interval of air 1-1000th of an inch in length. An electric machine of moderate power, and furnished with a suitable conductor, is competent to urge its current across an interval ten thousand times as great as this.

112. The electric spark passes through air by the agency of the particles of the conductor from which it springs, and which are carried forward by the discharge.

113. But, measured by other standards, the frictional current is almost incomparably more feeble than the voltaic current: for example, it is not without special arrangements for multiplying the effect that the current from a large electrical machine is enabled to deflect a magnetic needle.

114. Faraday immersed two wires, the one of zinc and the other of platinum, each 1-13th of an inch in diameter, in a cell of acidulated water. The depth of immersion was only  $\frac{1}{2}$  inch, and the time of immersion only 3-20ths of a second; still, he found that the electricity generated by this small apparatus, in this brief time, produced a distinctly greater effect upon a magnetic needle than twenty-eight turns of the large electric machine of the Royal Institution.

115. A cubic inch of air, if compressed with sufficient power, may be able to rupture a very rigid envelope; while a cubic yard of air, if not so compressed, may exert but a feeble pressure upon the surfaces which bound it. Now, the electricity of the machine is in a condition analogous to the compressed air; its density, or, as it is sometimes called, its intensity or tension, is great. The electricity from the voltaic battery, on the other hand, resembles the uncompressed air; it exceeds enormously, in *quantity*, that from the machine, but it falls enormously below it in intensity.

116. The deflection of a magnetic needle, and other actions of the voltaic current, depend solely upon quantity; hence the vast superiority of the voltaic current in producing such deflection.

117. Faraday found the quantity of electricity disengaged by the decomposition of a single grain of water in a voltaic cell (see Note 5) to be equal to that liberated in 800,000 discharges of the great Leyden battery of the Royal Institution: this, if concentrated in a single discharge, would be equal to a great flash of lightning. He

also estimated the quantity of electricity liberated by the chemical action of a single grain of water on 4 grains of zinc to be equal in quantity to that of a powerful thunder-storm.

118. Weber and Kohlrausch have found that the quantity of electricity associated with 1 milligramme of hydrogen in water, if diffused over a cloud 1000 metres above the earth, would exert, upon an equal quantity of the opposite electricity at the earth's surface, an attractive force of 2,268,000 kilogrammes.\*

## ROYAL IRISH ACADEMY.

At the last meeting of this Society, held at their House, PROFESSOR JELLET in the chair, Dr. R. M'DONNELL, F.R.S., read a paper on "*A New Theory of Nervous Action as regards the Propagation of Sensation Along the Nerves.*"

The author's paper might be briefly described as an application of a theory similar to the wave theory of light to the propagation of sensation along the nerves. He compared this "undulatory" theory of nervous conduction with the hitherto more generally received hypothesis of distinct nerve-conductors, supposed to exist for each kind of sensation, pain, heat, tickling, &c.; and attempted to point out that the former is at once a simple hypothesis, and more in harmony with the ideas now prevalent as to the propagation of light, heat, electricity, &c.

The author also dwelt upon many points of analogy between the absorption or interception of waves of heat or of light and the somewhat similar phenomena as regards nerve-conduction where one kind of sensation is felt and another ceases to be any longer perceived, as in cases where the patient feels the contact of the hand, but cannot distinguish heat, or *vice versa*.

## CORRESPONDENCE.

### ANALYSIS OF WATER.

*To the Editor of the Chemical News.*

SIR,—In your last number Mr. Spiller has commented on Professor How's analyses of an acid water from the coal-field at Stellarton. He thinks he has detected "one or two anomalies in the paper, which seem to have escaped the attention of the author, as well as of the gentlemen composing the 'committee of publication' of the *Chemical Society's Journal*;" and the first of these is an unusual arrangement of the constituents by which the chlorides of potassium and sodium are made to exist in solution in the presence of free sulphuric acid. Now, in reading the paper as it passed through the press I did observe this; but it never entered into my mind that it was my duty to correct the author's arrangement, especially as I thought he had as good a right to adopt that arrangement as any other of the same kind. No doubt it would have been more in accordance with received tradition to join the sulphuric acid to the potassium on the old principle of the strongest base to the strongest acid; but this rule is little else than an Idol of the Theatre, and there is this awkwardness about its application to the case in question that we do not know which is the stronger base potassium or sodium, or which the stronger acid, sulphuric or hydrochloric. In fact, there must have been both acids in a free state in the well and pond, for it has been established—at least, I consider it so—that where compounds of several bases and acids come together in solution, each acid arranges itself in combination with

\* The metre is a yard and one-eighth in length; the milligramme is 1-28000th of an ounce; the kilogramme is 2 lbs. 3 $\frac{1}{4}$  ozs.



each base in certain definite proportions dependent on the quantity of each of the constituents, and probably on the temperature: but what these proportions are in a colourless water no one can say; even the refractive index will scarcely help us.

It is true the results of these analyses might have been put down as so much calcium, magnesium, iron, potassium, sodium, and hydrogen, combined with so much chlorine,  $\text{SO}_4$ , and  $\text{SiO}_4$ , but neither the public nor chemists themselves are, perhaps, quite prepared for such a mode of representing the salts that exist in a water.

Should Mr. Spiller's letter, and this one, start a discussion as to the best method of recording the results of analysis in similar cases, they will do some good service.

How "a little alumina" got into the boilers is a question I shall leave for Professor How, if he chooses to explain it.

The third objection is of a totally different nature, and seems to arise from a misapprehension of Professor How's meaning. The statement that "the pond rests upon the measures immediately underlying the Acadia seam of coal" is intelligible enough if we remember what geologists mean by the term "underlying." If I am not misinformed these coal seams crop out at the surface, and that at a considerable angle; hence there is no difficulty in imagining a pond on the underlying coal measures in some place where the upper stratum has been removed either by the processes of nature or by the miner's art.—I am, &c.,

J. H. GLADSTONE.

May 30, 1870.

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

*Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

*Comptes Rendus des Séances de l'Académie des Sciences, May 23, 1870.*

Leaving aside the papers and memoirs relating to pure and applied mathematics, and to natural history, this number contains the following original memoirs and communications relating to chemistry and collateral sciences:—

**Action of Water upon Iron, and of Hydrogen upon Oxide of Iron.**—H. Sainte Claire-Deville.—The author relates, at great length, a series of experiments which may be summarised as follows:—Perfectly pure iron, kept at temperatures varying from  $150^\circ$ – $1600^\circ$ , is treated with vapour of water of a known tension and temperature. Under these conditions, the following results are obtained, which prove that the decomposition of vapour of water by iron, while red-hot, is rigorously subject to all the laws which govern the tension of saturated vapours. The author states that, according to his experience, all changes of the state of aggregation must be strictly analogous, because the predominating phenomenon in all is the evolution or absorption of latent heat.

**Fire-Clay made Stoves manufactured by MM. Muller and Co., Ceramic Manufacturers at Ivry.**—General Morin.—The author states that the experiments made with these stoves at the Conservatoire des Arts et Métiers are highly satisfactory. The useful effect of heat given off by the fuel (coke) amounts to 0.93 per cent. The air in the rooms where these stoves were placed was not at all vitiated so as to incommode those present, notwithstanding the interior of the stoves (that part wherein the fuel is placed) became thoroughly red-hot. The author says that, taking all in all, these stoves, when suitably connected with flues, will afford a cheap, and, in every respect, wholesome mode of heating apartments.

**On the Hail which Fell at Paris during a Thunderstorm on the 22nd of May last.**—A. Trécul.—It appears that a heavy thunderstorm took place, accompanied by hailstones of extraordinary size (2 centims. by  $1\frac{1}{2}$ ) as well as shape (pyriform). A portion of most of them was, as usual, opaque; but a great many were partly opaque,

and partly transparent and crystalline, in a peculiar and (for water) very unusual shape. Dr. Chapelas states, in relation to the storm alluded to, that it stands, according to his observations, in a very intimate relation to the Aurora Borealis seen on the 20th of May, and then accompanied by peculiar perturbations of the instruments applied for meteorological observations.

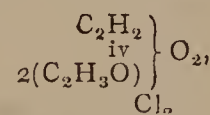
**Report on a Memoir written by Dr. Vétillart, "On the Vegetable Fibres Applied to Industrial Purposes."**—Professor Chevreul.—This lengthy paper gives a brief outline of the extensive researches made on flax, hemp, cotton, jute (*Corchorus capsularis*), China grass (*Urtica utilis*), and New Zealand flax (*Phormium tenax*). Owing to the importance of the contents of this paper, wherein very accurate and readily executed tests are given for the purpose of detecting the kind of various vegetable fibres, we intend to give a more extended account of the memoir at a future time.

**On the System of the Mineral Lodes of the Hunsrück.**—A. Vézian.

**Compressibility of Gases under High Pressure.**—L. Caillietet.—The author has studied the variation of compression of air and hydrogen between 1 and 800 atmospheres. Up to 80 atmospheres' pressure, air is more compressed than it should be if it followed the law of Mariotte; and at 680 atmospheres' pressure it only occupies two-thirds of the space which it ought to do theoretically. The method by which the author is enabled to measure the volumes occupied by a gas in an opaque apparatus is very simple. The glass tube is enclosed in an iron one, the former, containing the gas, is lightly gilt. The mercury, which serves for the transmission of pressure, whitens the gold, leaving a well-defined mark on it after the pressure ceases.

**Combinations of Protochloride of Platinum and Oxide of Carbon.**—Dr. J. Schützenberger.—The author describes three new compounds, viz.:— $\text{COPtCl}_2$ , chloroplatinate of carbonyl, the most stable of these bodies, fusing at  $194^\circ$ ;  $\text{C}_2\text{O}_2\text{PtCl}_2$ , chloroplatinate of dicarbonyl, fuses at  $142^\circ$ ;  $\text{C}_3\text{O}_3\text{Pt}_2\text{Cl}_4 = \text{COPtCl}_2 + \text{C}_2\text{O}_2\text{PtCl}_2$ , a compound of one molecule of each of the preceding bodies, fusible at  $130^\circ$ . Water decomposes these substances instantaneously, platinum being set free and chlorhydric and carbonic acids formed, or, also, sometimes a mixture of carbonic acid and carbonic oxide. Alcohol also decomposes these substances.

**Action of Acetylen upon Mixed Aceto-Hypochlorous Anhydride (Acetate of Chlorine).**—M. Prudhomme.—The author describes, at length, a series of experiments, resulting in the discovery of a body—



that is to say, the aceto-chlorhydrine of a tetratomic alcohol.

**Action of Sulphuric Anhydride upon the Protochloride and Sesquichloride of Carbon.**—M. Prudhomme.—With the protochloride of carbon,  $\text{C}_2\text{Cl}_4$ , anhydrous sulphuric acid yields, on being heated in a sealed tube to  $150^\circ$ , sulphurous acid and chloride of trichlorated acetyl,  $2(\text{C}_2\text{Cl}_4) + \text{S}_2\text{O}_6 = 2(\text{C}_2\text{Cl}_4\text{O}) + \text{S}_2\text{O}_4$ ; with the sesquichloride of carbon,  $\text{C}_2\text{Cl}_4\text{C}_2$ , the same body, and, in addition thereto, oxychloride of sulphur,  $\text{S}_2\text{O}_5\text{Cl}_2$ , is obtained,  $\text{C}_2\text{Cl}_6 + \text{S}_2\text{O}_6 = \text{C}_2\text{Cl}_4\text{O} + \text{S}_2\text{O}_5\text{Cl}_2$ .

**Observations on the Batswing-Burner Flame.**—A. Baudrimont.—The chief point of interest is that the aforesaid flame consists of two distinct portions, one of which (the interior) has a comparatively low temperature, while it is surrounded by a luminous envelope, the temperature of which exceeds that of molten platinum. Indeed the author found that a platinum wire 1-10th m.m. thick, when properly placed in this flame, fused immediately.

**Two Instances of Upheaving of the Soil recently noticed.**—Dr. de Botella.—The author, writing from Madrid to M. Elie de Beaumont, states that the steeples of the villages of Benifarzes, and the entire village of Salduende, have been considerably lifted up (upheaved), since 1847, in a direction nearly parallel to the system of the Saucerrois. The extreme distance between the upheaved points is 300 kilometres. The celebrated geologist to whom this communication is made said, at the meeting, that something similar was observed some years ago in the Kingdom of Wurtemberg, and that it is very probable that, if well conducted observations in this direction are set on foot, many such facts will come to be noticed.

*Zeitschrift für Chemie von Beilstein, No. 8, 1870.*

This number contains the following original papers, nearly all of which were read at the Imperial Russian Chemical Society, at the late meetings of that Society:—

**Nitro Compounds.**—A. Engelhardt and P. Latschinoff.—The chief object of this very lengthy paper is to prove that the so-called nitro-compounds, which are usually considered to be products of a metaleptic displacement of hydrogen by the nitro group  $\text{NO}_2$ , so that the chemical functions of the bodies which undergo this substitution remain the same, are really so altered, as regards their properties and characters, as if the body in which the substitution took place was oxidised. The authors have made a lengthy series of experiments to prove their statement; and the paper is divided into the following sections:—Nitrophenols and benzols; action of pentachloride of phosphorus on ortho-nitrophenol; phosphoric acid ortho-nitrophenol,  $[\text{C}_6\text{H}_4(\text{NO}_2)]_3\text{PO}_4$ ; action of  $\text{PCl}_5$  upon volatile nitrophenol; nitrochlorobenzols; nitrobichlorobenzols; binitro-phenol and binitrochlorobenzol; binitro-bichlorobenzol; trinitro-phenol and trinitrochlorobenzol. The authors classify the nitro compounds of phenol



according to their behaviour with  $\text{PCl}_3$ , and also according to the properties of their chloranhydrides and amides, in the following manner:—

	Chloranhydrides.	Amides.
Phenol.	Chlorobenzol.	Aniline.
Ortho-nitrophenol.	$\alpha$ Nitro-chlorobenzol.	$\beta$ Nitraniline (Hoffmann's).
Volatile nitrophenol.	$\beta$ Nitro-chlorobenzol.	
Dinitrophenol.	Dinitro-chlorobenzol.	Dinitro-aniline.
Trinitrophenol.	Trinitro-chlorobenzol.	Trinitro-aniline.

In this grouping, the acid character of each succeeding compound becomes stronger.

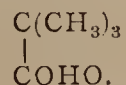
**Butylen.**—A. Butlerow.—The main gist of this paper is to establish the author's priority of certain researches made by him, and the correction of some errors committed by Dr. Markownikoff in his paper published in the Russian language on butylen.

**Preparation of Trimethyl-Carbinol from Isobutyl-Alcohol.**—A. Butlerow.—Iodisobutyl is first prepared by passing HI into boiling butylic alcohol. This substance is next employed for the preparation of butylen in the following manner:—4 parts of potassic alcohol (consisting of 1 part of KHO and 3 parts of alcohol 90 per cent), 1 part of solid caustic potassa, and 2 parts of iodisobutyl are mixed and gently heated. The butylen (a gas) is collected in a gas-holder, after having been washed with alcohol and water. The butylen is converted into trimethyl-carbinol by a complicated process, based upon the complete absorption of butylen by sulphuric acid (3 parts  $\text{H}_2\text{SO}_4$  and 1 part  $\text{H}_2\text{O}$ ), and its conversion thereby into a liquid which, after saturation with  $\text{K}_2\text{CO}_3$ , and distillation, yields the compound in question.

**On Isomeric Dibromotoluols.**—E. Wroblevsky.—The author's researches have been made with the view of obtaining compounds different from those obtained by Dr. Fittig by the direct action of bromine upon toluol. For this purpose, solid toluidine was brominated, and the product converted into azoperbromide,  $\text{C}_7\text{H}_6\text{BrN}_2\text{Br}_3$ ; and this substance made the starting-point for the preparation, first, of dibromotoluol,  $\text{C}_6\text{H}_3\text{Br}_2\text{CH}_3$ , a liquid not solidified even at  $-20^\circ$ , boils at  $239^\circ$ , sp. gr. 1.812 (at  $19^\circ$ ), soluble in alcohol, and yields, when nitrated, only one nitro-dibromotoluol,  $\text{C}_7\text{H}_5(\text{NO}_2)\text{Br}_2$ , a solid crystalline substance fusing at  $87^\circ$ . The author further describes—Dibromotoluidine; another dibromotoluol,  $\text{C}_7\text{H}_6\text{Br}_2$ ; dibromonitrotoluol; dibromotoluidine; nitro  $\alpha$  bromtoluol; nitro  $\sigma$  bromtoluol; and nitro- $\beta$  iod- $\sigma$  bromtoluol.

**Products of Decomposition of Glycogen by Sulphuric Acid.**—Dr. A. Stscherbakoff.—After referring to Dr. Tichanowitsch's work on the origin of the hydrates of carbon within and without the animal organism, published in the Russian language, at Cherkow, the author describes a series of physiologico-chemical experiments, the main result of which is that the composition of glycogen is to be expressed by  $\text{C}_{30}\text{H}_{50}\text{O}_{25}$ .

**Preliminary Notice on a New Valerianic Acid.**—A. Butlerow.—The author states that he has succeeded in obtaining from trimethyl-carbinol a valerianic acid—



**Explanation of the Action of Peroxide of Manganese upon Chlorate of Potassa in the Preparation of Oxygen.**—Dr. G. Krebs.—The utility of mixing peroxide of manganese, for which, however, may be substituted substances such as peroxide of iron, oxides of zinc and tin, burnt gypsum and others, provided they are previously well dried (best by ignition) with chlorate of potassa, is based upon the fact that the substances alluded to, which are infusible by themselves, are the carriers and transferrers of heat to the chlorate of potassa, each particle of which is surrounded with a source of heat, which aids its rapid decomposition. The peroxide of manganese is prevented from being itself decomposed, because the chlorate of potassa withdraws from it heat, for the purpose, first, of its own fusion, whereby heat becomes latent; secondly, by its decomposition. The author states that, when oxide of iron, or peroxide of manganese, are strongly heated in a crucible, and chlorate of potassa very gently fused at the same time, by itself, in a porcelain dish, the addition of the hot (not red-hot) oxides to the fused chlorate causes the evolution of oxygen to set in instantaneously, and with so great violence that, unless this experiment be performed in open vessels, and with small quantities at a time, serious explosions may occur.

*American Journal of Pharmacy*, May, 1870.

Leaving aside the bulk of those original papers which relate strictly to pharmacy, and which are very valuable, this number contains the following original papers relating to chemistry and collateral sciences:—

**Pumpkin Seeds.**—Benton G. Bosch.—The author's researches on this subject have proved that these seeds contain 75 per cent of an oily kernel and 25 per cent of husk. The oil, extracted by ether, resembles, in taste, olive oil. The kernel contains, moreover, an oleo resin, to which, the author believes, the efficacy of the drug is due; this principle he calls *cucurbutin*—it is an anthelmintic.

**Active Principle of the Catalpa Bignonoides.**—E. A. Rau.—The author has investigated the bark of this tree, rejecting the outer corky layer, by a process too lengthy to be described here. He found a crystalline substance, insoluble in water and dilute alcohol, best dissolved in ether and chloroform. This substance, also insoluble in dilute alkalies and acids, was found to be neutral and free from ash; the taste of this substance was found to be intensely nauseous and

bitter. The author also found a glucoside, a tasteless resin, and tannin.

**Sulphate of Lime, an Impurity in Tincture of Chloride of Iron.**—Dr. R. Battey.—The author records that the pharmaceutical preparation alluded to often deposits long, slender, delicate needles, along with a yellowish precipitate. On investigating these crystals, he found them to be sulphate of lime; but there is no necessary connection between that substance and the yellowish deposit, the nature of which is not further alluded to.

**Light Sulphate of Quinine.**—L. Strehl.—The author, writing from Chicago, U.S., reports that a small parcel of quinine was recently purchased there, labelled "light sulphate of quinine," manufactured by Lord, Bros., Ludgate Hill, London. That firm being unknown, the "quinine" was submitted to the ordinary tests for purity, and was discovered to exhibit a rhombic, prismatic, crystalline structure, taste bitter, entirely soluble in cold water, no indications of the presence of quinine with chlorine-water and ammonia, nor also with the former and ferrocyanide of potassium, and afterwards a few drops of ammonia. No sulphuric acid was detected, but, instead thereof, hydrochloric acid. All the reactions made confirmed the idea that, instead of the substance being sulphate of quinine, it was hydrochlorate of cinchonine. That salt resembles closely, in appearance, sulphate of quinine, and is a substitution which might readily pass unnoticed.

**Remarks on Granular Citrate of Magnesia.**—H. C. Archibald.—After referring to the so-called citrate of magnesia of the English trade, which the author states to be made up of tartaric acid, bicarbonate of soda, sugar, and a trace of magnesia, the author states that, to obtain a preparation that could be properly called granular citrate of magnesia, by the direct union of citric acid and magnesia, and having, at the same time, effervescing properties, was found to be impracticable. After a series of experiments to ascertain whether a granular salt could be made which would contain citrate of magnesia, and be at the same time effervescent and perfectly soluble, the following formula was adopted, which, if strictly adhered to, will afford a beautiful salt, possessing decided laxative properties and very acceptable to the palate:—Take of powdered citric acid, 4 lbs.; calcined magnesia,  $1\frac{1}{2}$  lbs.; bicarbonate of soda, 3 lbs.; tartaric acid, 3 lbs.; powdered white loaf sugar, 6 lbs.; essential oil of lemons,  $\frac{1}{2}$  fluid oz.; alcohol (very strong), q.s. To the powdered citric acid add the sugar, and mix thoroughly; then add the soda, magnesia, and tartaric acid. Pass the whole through a No. 40 sieve three times, to insure thorough mixture; moisten the powder with strong alcohol and pass through a No. 8 sieve and place on a wooden tray to dry, at a temperature of  $120^\circ\text{F}$ . Add the oil of lemons when dry, and bottle instantly in well dried and clean bottles. This preparation can be kept indefinitely without injury, is freely soluble in water without residue, has a pleasant taste, and is in very great request in the United States; undoubtedly, this preparation is far to be preferred above what goes by the name of effervescing citrate of magnesia in this country.

**On a Brown Hair-Dye.**—G. McDonald.—Under this title the author, in reality, makes known a fact which is worthy of notice; he says, the well-known fact that a soluble compound of lead and sulphur could not be obtained by the decomposition of a soluble lead salt by a soluble sulphuret, or, in other words, the insolubility of the sulphuret of lead was regarded as an indubitable proof of the folly of undertaking to search for a compound containing sulphuret of lead in a soluble state, and yet so as to be innocuous to the system. There is a class of salts known as hyposulphites, many of which are freely soluble in water, and which are readily converted by absorption of oxygen into sulphate of the base and free sulphur; it is in the use of these salts that the key to the enigma lies. Chemical text-books state that hyposulphite of lead is insoluble in water, which is quite correct; but, like many other precipitates insoluble in water, it is readily dissolved by an excess of the precipitant; thus, if we add to a solution of three parts of acetate of lead two parts of hyposulphite of soda, we shall have a curdy white precipitate of hyposulphite of lead, insoluble in water; but if we add to this ten parts more of hyposulphite of soda the precipitate will be re-dissolved, and a perfectly clear solution will be the result; this solution, when applied to the hair, is decomposed by absorption of oxygen; one of the results thereof is the formation of the dark brown sulphuret of lead, it is to the formation of this compound in the hair that all lead and sulphur dyes owe their efficacy.

*Cosmos*, May 21, 1870.

**Reorganisation of the Ministry of Public Instruction.**—By a decree, dated May 15th, M. Mège, Bâtonnier de l'Ordre des Avocats at Clermont Ferrand, has been appointed Minister of Public Instruction. This gentleman was born at Riom, September 15th, 1817; by a decree of the same date, there has been established a Ministry of Literature, Sciences, and Fine Arts, and a series of institutions, hitherto under the control of the Minister of Public Instruction, and among these the Imperial Institute, several libraries, and schools, have been placed under the newly established ministry.

**Discovery of Fossil Bones near Durfort (Gard).**—Cazalis de Foudouce.—The author, while on his way to Boumadas Morts, had his attention attracted by what appeared at some distance to be an elephant's tooth laying on a heap of stones, along the road from Alais to Vigan; on approaching the object he found it to be what he believed, and on making inquiry with the Cantonier (men stationed along the road during a portion of the day, to see to its being kept in proper repair; they are under the orders of the Ingénieurs des Ponts et Chasseurs) the stones (intended for the repair of the road) were traced to their origin; upon search being made near that spot, a tolerably complete skeleton of the *Elephas primigenius* was found in a locality where,



judging by its well-known geological features, this was hardly to be expected; the author relates at great length all the particulars, including the size of the parts of the animal recovered.

**Chemical Treatment of Flax.**—M. Magne.—The author treats this fibre alternately with weak caustic alkalies and alkaline hypochlorites, at temperatures ranging from 20° to 50°; the last trace of alkali is washed out with weak hydrochloric acid; the fibres thus prepared are stated to be bleached better than by any other process.

**Testing Glue for its Good Quality.**—Dr. Chabrier.—The author states that the best means of ascertaining the goodness of glue consists in estimating the quantity of pure gelatine it contains, and for this purpose he suggests the use of a solution of pernitrate of mercury in water acidulated with nitric acid; the operation is carried out volumetrically, the solution of mercury salt being titrated with a solution of pure gelatine in known quantity dissolved in water.

May 28, 1870.

**New Electric-Magnetic Apparatus.**—Dr. Demazet.—The author describes, at length, an apparatus constructed by him, which appears to be an improvement of Siemens's; while making from 250 to 280 revolutions a minute, the lifting power of the magnet is 70 kilos., and under similar conditions a platinum wire, 0.8 m.m. thick and 20 centim. long, was rendered red-hot, and iron wire of the same thickness fused; the machine produces, per second of time, half a c.c. of gas by the decomposition of water.

**Acclimatisation of the Eucalyptus Globulus.**—Dr. Cloëz.—The tree alluded to, a native of Tasmania, is highly esteemed, both on account of the durability of its wood, which is very hard and superior to teak wood, and because its leaves contain a peculiar camphor-like essence, which dissolves caoutchouc more readily than sulphide of carbon does, and is also a solvent for copal; the tree is reputed to have febrifuge properties, because it is said that fever is never known where it is abundantly found. The neighbourhood of Paris is too cold, and the soil not suitable for its growth there; but in the southern parts of France, as well as in Spain (where the tree thrives well) this beautiful plant will be very useful as a forest tree; it reaches in its native clime enormous height and size.

*Revue Hebdomadaire de Chimie*, May 12, 1870.

**Echardonnage of Wool by Chemical Means.**—Dr. Schaller.—By *échardonnage* is understood an operation intended to destroy in wool the particles of straw and vegetable fibre accidentally adhering to it or left in it after having been treated with the teazle, still used sometimes in preference to the carding machine. The author impregnates the wool with a mixture of common salt and dilute sulphuric acid; the excess of this liquid is squeezed out between properly arranged cylinders, and the textile fibre is next exposed to a heat of 130°, which, aided by the hydrochloric acid evolved from the mixture above named, causes the carbonisation of the cellulose, leaving the wool untouched; this latter is next washed in a slightly alkaline liquid, and is then fit for the mechanical operations required before spinning the wool.

**Manufacture of Red Lead from Nitrite of Lead.**—M. Pichon.—After referring to the fact that the red lead (minium) of commerce almost always contains some metallic lead and some oxide of lead (massicot), incompletely oxidised, the author proposes to take nitrate of lead and granulated metallic lead in the proportions of one equiv. of nitrate to four of metal; these materials are placed in a cast-iron cauldron, lined inside with lead; water having been added, the mixture is heated to 60° or 80°; after two hours time a yellow sandy mass is found to have settled at the bottom of the vessel; the liquid should then be decanted into a leaden vessel, wherein the nitrite of lead soon crystallises; after the crystals have been drained they are decomposed by means of heat, by being placed for that purpose into retorts similar to those in use for the manufacture of nitric acid; the acid vapours given off are condensed by suitable means, and the oxide of lead, which is deep black coloured and perfectly homogenous, thus obtained is employed for the manufacture of red lead instead of massicot; the red lead thus produced is, according to the author, perfectly homogeneous, free from lead, and its composition is  $3\text{PbO}_4 + \text{PbO}_2$ ; there is a difference of opinion as regards the formula to be assigned to minium— $\text{PbO}_2 + 2\text{PbO}$  (Dumas);  $\text{Pb}_2\text{O}_3, \text{PbO}$  (Winkelblech);  $\text{Pb}_2\text{O}_3, 4\text{PbO}$  (Longchamp);  $\text{Pb}_4\text{O}_5$  (Mulder).

May 19, 1870.

**Comparison between the Steam Generating Power of Coal when Burned, and of the Combustion of the Heavy Oils.**—H. Sainte-Claire Deville.—This paper is a good abstract of the several papers which have appeared on this subject in the *Comptes Rendus*.

**New Method of Copper Extraction, and its Separation from other Metals.**—J. Elkington.—The principle applied by the author consists in applying electricity for dissolving the copper contained in the crude metal obtained by the usual smelting methods, and for depositing that metal galvanically upon plates of copper, causing the other foreign metals to fall to the bottom of the vessels in which the operations take place; copper, containing very small quantities of silver, may be advantageously treated thus for the recovery of the last-named metal.

**So-called Annular Furnace or Kiln for the Continuous Operations of Burning Bricks, Lime, Porcelain, Cement, &c.**—F. Hofmann.—Illustrated with woodcuts.

**On the Salts of the Cerium Metals.**—M. Zschiesche.—The author has studied some of the salts of the metals jointly found in the mineral cerite. Chloride of lanthanum,  $\text{LaCl} + 5\text{HO}$ , forms large colourless crystals, which are not deliquescent; oxalic acid precipitates from acid solutions of didymium the oxalate of that metal in insoluble state similar to chloride of lead; on being heated to a redness it first yields a carbonate, and at a very high temperature a peroxide; the sulphate of didymium is  $\text{DiOSO}_3 + 3\text{HO}$ . Among the cerium salts the author studied the salt yielded by the oxide which results from the ignition of the oxalate of cerium; this oxide, when dissolved in sulphuric acid, yields a red-coloured salt— $5\text{CeOSO}_3 + \text{Ce}_2\text{O}_3, 3\text{SO}_3 + 27\text{HO}$ ; and a yellow-coloured mixture of the last and some sulphate of protoxide.

**Oxyhydrogen Blowpipe, called Universal.**—M. Delaporte.—The chief point of difference of arrangement in this apparatus consists in having several jets for the hydrogen, and only one for the oxygen; this latter gas, the heavier, is made to fall as it were and convey the other. The effect is the production of a lance-shaped flame of great power; proper precautions are provided to prevent explosions.

**Analysis of the Water of the Grosnard Spring intended to Supply the Town of St. Guentin.**—J. Vivien.—Ten litres of this water contain, in grms.:—Carbonate of soda, 0.0510; carbonate of lime, 2.3480; carbonate of magnesia, 0.1530; nitrate of lime, 0.4539; nitrate of magnesia, 0.0559; sulphate of lime, none; chloride of potassium, 0.2196; chloride of sodium, 0.1233; silicate of soda, 0.0371; free silica, 0.0170; organic matter, 0.0210; total, 3.3898.

## NOTES AND QUERIES.

**Phosphate of Ammonia.**—Will any of your readers kindly furnish me with a process for the manufacture of phosphate of ammonia from bone-ash.—J. W. M.

**Oxygenated Water.**—Will any of the readers of the *CHEMICAL NEWS* oblige J. C. with the method and utensils adopted in the manufacture of oxygenated water, or say where he may gain such information?

**Chrome Colour.**—"Colourman" offers his best thanks for the answers given to his query. As *Dingler's Polytechnisches Journal* is not within his reach, may he trespass once more by asking if a formula is given for producing a good vermilion-red chrome colour?

**Erecting Prism.**—Referring to Prof. Morton's very ingenious plan of erecting the image given by a magic lantern, I beg to inform you that I have made the prism (Fig. 2, p. 246 of the *CHEMICAL NEWS*) some two or three years since, for Prof. Herschel, of the Andersonian College, Glasgow; and I have one of these prisms by me at present.—JOHN BROWNING.

**Volumetric Estimation of Chlorine.**—In the *CHEMICAL NEWS* (vol. xxi., p. 217), I notice the estimation of chlorine by means of nitrate of silver and chromate of potassium solution. The process is by no means new; it can be found at p. 183 of Sutton's "Volumetric Analysis," 1863. I used the method in various instances as far back as 1864, with much success.—T. B.

**Tungsten Blue.**—In the *CHEMICAL NEWS* (vol. xxi., p. 130) appears an extract from *Les Mondes* relating to tungsten blue. Will any one of your readers be kind enough to inform me whether he has succeeded in making the blue according to the process there given, and, if so, state his opinion of its value? Says the extract, it "is sold at the same price as the very best quality of Prussian blue." May I ask where a sample can be purchased?—T. W. S.

## MEETINGS FOR THE WEEK.

- MONDAY, June 6th.—London Institution, 4.  
Royal Institution, 2. General Monthly Meeting.
- TUESDAY, 7th.—Ethnological, 8.  
Royal Institution, 3. Prof. Seeley, "On Present English History."
- WEDNESDAY, 8th.—Microscopical, 8.  
Geological, 8.
- THURSDAY, 9th.—Royal Institution, 3. Prof. Tyndall, "On Electricity."  
Zoological, 8.30.
- FRIDAY, 10th.—Royal Institution, 8. Prof. Odling, "Ammonia Compounds of Platinum."  
Astronomical, 8.  
Quekett Microscopical Club, 8.
- SATURDAY, 11th.—Royal Institution, 3. Prof. Grant, "Astronomy of Comets."  
Quekett Microscopical Club. Excursion to Elstree. To meet at St. Pancras Station, at 1.30 p.m.

## TO CORRESPONDENTS.

F.C.S.—We think it may.

T. Summers, jun.—1. The full account will be found in the *Bulletin de la Société d'Encouragement* for 1869, 2e serie, t. xvi., p. 277. Apply to Asher and Co., Bedford Street, Covent Garden. 2. We know of no work devoted entirely to the subject; it is treated of in the *Dictionaries of Chemistry*.



# THE CHEMICAL NEWS.

VOL. XXI. No. 550.

## NOTE ON THE HOMOLOGUES OF CUPRIC ACETO-ARSENITE (SCHWEINFURT GREEN).

By P. S. ABRAHAM, B.Sc.,  
Exhibitioner at the Royal College of Science, Dublin.

I HAVE recently found that, if cupric formiate, butyrate, or valerianate be substituted for cupric acetate in the process for the manufacture of Schweinfurt green, compounds are obtained similar in colour to the well-known green, but containing formic, butyric, or valerianic acid in place of the acetic.

For the preparation of cupric formo-arsenite, 4 parts of cupric formiate were dissolved in as little water as possible, and added to 4 parts of arsenious acid dissolved in about 50 parts of water by the aid of a little caustic soda; both solutions being at the boiling-point. The yellowish precipitate which appeared soon became of a very bright green, with a slightly more yellowish tinge than the acetic compound.

The butyric and valerianic greens were made in a similar manner, but with different proportions of cupric salt and arsenious acid.

## NEW METHOD OF HEATING STONEWARE VESSELS, AND OF OBTAINING REGULATED HIGH TEMPERA- TURES.

IN conducting chemical and pharmaceutical operations for manufacturing purposes, it is generally necessary to effect evaporation and distillation in stoneware vessels; but great difficulty has been hitherto experienced in obtaining a sufficiently high temperature without cracking or breaking the pan employed. The use of a naked fire inevitably causes a fracture; and a sand-bath offers too great an obstruction to the passage of the heat. With a steam-jacket, it is impossible even to raise water to the boiling-point, unless, indeed, such a pressure of steam be applied as to cause a very dangerous strain on the flanges of the vessel.

A new method of applying heat, however, has been patented by Mr. J. A. Coffey, the pharmaceutical engineer, and is now introduced by Messrs. Doulton and Watts, for working stoneware pans and stills, by which any temperature ranging from 100° to 700° F. can be safely and easily obtained.

Mr. Coffey's principle is to cause heavy paraffin-oil to circulate, first through a coil of pipes in a furnace, and then through the jackets of the pans. The oil is carefully selected for the purpose, from the heaviest of the petroleum or paraffin products. It moves by its own convection. Heated in a close coil of pipe by a coke fire, it rises into an air-tight tank, from which it passes, through pipes, to the jackets of the different vessels to be heated, returning, after it has done its work, to the lowest part of the furnace-coil; a continuous circulation is thus maintained, similar to that which occurs in a hot-water apparatus for warming buildings. After leaving the tank, the oil passes

through a pyrometer, by which its temperature is indicated, and, by means of dampers, &c., to the fire this can be regulated to any required point. The heating medium is turned on or off the jackets by taps, in the same manner as steam; and, as the rate of flow can be checked or augmented at will, the temperature is perfectly under the control of the operator.

In the model which has been fitted up at Messrs. Doulton and Watts's to illustrate the principle of this method of working, the pyrometer generally indicates from 600° to 700° F., while a saturated solution of chloride of calcium is maintained at the boiling-point in a shallow stoneware pan. No smell of oil is perceptible in the room; and it is stated that the same oil may be used for years, without deterioration or causing any deposit in the pipes. As contrasted with steam-heat, the inventor claims for his process a saving of 30 per cent in fuel. It is obvious that the large amount of heat necessary to convert water at 212° F. into steam at 212° is hereby economised. The stoneware used in this process is manufactured expressly by Messrs. Doulton, to ensure its being quite impervious to the oil.

Other applications of this method of conveying heat are included in Mr. Coffey's patent; but its easy adaptation to heating stoneware will probably be of the most interest to chemists.

## AMMONIUM AMALGAM AND HYDROGENIUM.

By Prof. C. A. SEELY.

AT the meeting of the Chemical Section of the New York Lyceum of Natural History, May 9th, 1870, Prof. C. A. Seely read a paper "*On the Constitution of Ammoniacal Amalgam*," of which the following is an abstract:—

Ammonium amalgam was discovered by Berzelius in 1808, and immediately after by Pontin, Seebeck, and Trommsdorff. Its easy preparation, singular properties, and its relation to current theories, have made it familiar to all chemists; it led to the adoption of Ampere's ammonium theory, gave a great impetus to the theory of organic radicals, and revived the notions of the alchemists of the compound nature of metals. Early in this century, it led many to conclude that the base of nitrogen is a metal; and, at the present time, without doubt, has assisted in giving currency to the notion that hydrogen is a metal. Except for it, perhaps the crudity, hydrogenium, would not have been inflicted upon us. Of course it has occupied a conspicuous place in chemical literature; scores of papers, and at least two books, have been printed about it.

The name ammonium amalgam expresses the supposed constitution of the substance; the radical ammonium is represented as dissolved in, or united with, mercury. The ammonium is, moreover, conceded to be a solid or a liquid, and to have a truly metallic character; thus the latest and best authorities present the case. It is described, in nearly all treatises on chemistry, as if its constitution was as certainly ascertained as that of common salt. There have been, from the beginning, however, those who doubted the prevailing ideas, and some (see Daniell's "Chemical Philosophy," p. 520; and Dr. Wetherill on "Ammonium Amalgam," in *Silliman's Journal*, vol. xl., p. 160) boldly objected to them; but the reasons they alleged had not sufficient weight. Ammonium amalgam has always been a pet with chemists; it has always been ready for the service of one theory or another. The ammonium theory, the radical theory, the nitrogen and hydrogenium theories, have each, in their turn, been of too much importance to permit any of their props to be withdrawn.

The author considers the so-called ammonium amalgam



to be a mechanical or physical mixture of liquid mercury with the gases ammonia and hydrogen, and that its semi-solid consistence is due to the mixture having the nature of a froth. When sodium amalgam is brought into a solution of sal ammoniac (the ordinary method of preparing ammonium amalgam), the chlorine combines with the sodium, and the residue ( $\text{NH}_3 + \text{H}$ ) of the sal ammoniac is set free all over the surface of the mercury; the particles of the mixed gases adhere to the mercury, and, by reason of the movement bringing to the surface fresh mercury, they become enfilmed and carried inward, until the mixture becomes a homogeneous froth. The principal considerations by which this view of the constitution of ammonium amalgam has been reached are as follows:—

1. The volume of ammonium amalgam is inexplicable in any other way. It is utterly inconsistent with the well-established laws of combinations by volume; there is no case of a liquid or solid chemical compound, or amalgam, which has any analogy to it.

2. Mercury has a mirror-like surface; while ammonium amalgam has comparatively a whiter and more dead surface: it approaches, in appearance, to matt silver. Such changes are characteristic of froths.

3. If ammonium amalgam be subjected to varying pressure, its volume changes, apparently, in accordance with Mariotte's law of gaseous volume. To illustrate this important fact, a glass tube,  $\frac{1}{4}$  inch in diameter, 20 inches long, and fitted with a plunger, was employed. Mercury containing a little sodium was poured into the tube to  $\frac{1}{2}$  inch in depth; and upon this was poured a strong solution of chloride of ammonium, occupying about 2 inches in length of the tube. The ammonium amalgam was completely formed in a few minutes, and occupies several inches of the tube. On adjusting and depressing the plunger, the volume of the amalgam progressively diminished till it closely approached the original volume of the mercury. Also, it was notable that the amalgam progressively gained fluidity and the mirror-surface, till, at the greatest pressure, it appeared like mercury. On withdrawing the pressure, the original volume and appearance of the compound were resumed; and, on reducing the pressure below that of the air, the amalgam still expanded, until it rose above the surface of the liquid in the tube. If the great pressure be maintained, more ammonium amalgam will be formed, the mass expanding progressively, apparently in accordance with the fact that the absorption or adhesion of gases to liquids is favoured by pressure. By means of the simple apparatus used, a pressure of ten atmospheres or a good vacuum are easily and at once obtainable, and the experiments with it are very striking.

The so-called ammonium amalgam is, therefore, not an amalgam at all. Ammonium is not proved to be a metal; and, if it be admitted that the monatomic radical really exists in ammonium amalgam, it is neither a solid nor a liquid, but a gas.

The considerations regarding ammonium amalgam are evidently equally applicable to Loew's hydrogenium amalgam; both are only metallic froths. The expansion of palladium observed by Graham, on its absorption of hydrogen, is probably analogous to the case in question. In both cases, the gases concerned are condensed, by reason of their attraction to the metal; and, if the molecules of palladium were made free to move, as those of mercury, it is probable that Graham's hydrogenium alloy would become a palladic froth, more remarkable than the corresponding mercuric froth. Many have erroneously supposed that hydrogen was conspicuous in its capability of being absorbed by metals, and thus have more readily been infused with the hydrogenium theory. Oxygen has an eminence over hydrogen in that property; and yet no one has a theory of oxygenium. Iron absorbs carbonic oxide; but no one is bold enough to suggest that carbonic oxide is a metal.—*American Gas-Light Journal*.

## A PROCESS FOR QUICKLY AND ACCURATELY DETERMINING THE AMOUNT OF CHROMIUM AND IRON IN CHROME IRON ORES.\*

By J. BLODGET BRITTON,  
Ironmaster's Laboratory.

REDUCE the mineral to the finest state of division possible, in an agate mortar. Weigh off 0.5 gm. and add to it 4.0 grms. of a flux, previously prepared, composed of one part chlorate of potassa and three parts soda-lime; thoroughly mix the mass by trituration in a porcelain mortar, and then ignite in a covered platinum crucible at a bright-red heat for an hour and a half or more. The mass will not fuse, but when cold can be turned out of the crucible by a few gentle taps, leaving the interior of the vessel clean and bright. Triturate in the mortar again and turn the powder into a tall 4-oz. beaker and add about 18 c.c. of hot water, and boil for two or three minutes; when cold, add 15 c.c. of hydrochloric acid of common strength, and stir with a glass rod for a few minutes, till the solid matter, with the exception, probably, of a little silica in a flaky gelatinous state, becomes dissolved. Both the iron and chromium will then be in the highest state of oxidation— $\text{Fe}_2\text{O}_3$  and  $\text{CrO}_3$ . Pour the fluid into a white porcelain dish of about 20 ozs. capacity, and dilute with washings of the beaker to about 3 ozs. Immediately after, also, pour cautiously into the dish 1.0 gm. of metallic iron of known purity, previously dissolved in dilute sulphuric acid and further diluted with cold water to about 5 ozs., to make up the volume in the dish to about 8 ozs. (I use for the purpose fresh borings from a piece of bar iron, containing less than 0.05 of foreign matter, dissolved in 18 c.c. of dilute sulphuric acid of 1 part acid and  $3\frac{1}{2}$  parts water, in a tube 12 inches long and  $\frac{7}{8}$  inch diameter, closed at the top with a gum stopper perforated for a  $\frac{1}{4}$  inch tube, bent short round at right angles and extending horizontally about three or four inches, applying heat to expel atmospheric air and facilitate operations). When the iron is dissolved, and having tested the solution for sesquioxide, I nearly fill the tube with cold water and cautiously pour the contents into the dish and add about two tubes-full more of cold water to make up the solution to about 8 ozs., and then determine, volumetrically, with a standard solution of permanganate of potash, the amount of protoxide of iron remaining. The difference between the amount of iron found and of the iron weighed will be the amount oxidised to sesquioxide by the chromic acid. Every one part so oxidised will represent 0.320 of metallic chromium, or 0.4663 of sesquioxide,  $\text{Cr}_2\text{O}_3$ , in which last condition the substance usually exists in the ore.

If the amount of iron only in the ore is to be determined, the process is still shorter. After the fluxed mineral has been ignited and reduced to powder, as already directed, dissolve it in a tube of the kind described, by adding, first, 10 c.c. of hot water and applying a gentle heat, and then 15 c.c. of hydrochloric acid, continuing the heat to incipient boiling till complete decomposition has been effected; cool by immersing the tube in a bath of cold water, add pieces of pure metallic zinc (sheet zinc cut in small strips I prefer) sufficient to bring the iron to the condition of protoxide and the chromium to sesquioxide, and apply heat till small bubbles of hydrogen cease, and the zinc has become quite dissolved; then nearly fill the tube with cold water, acidulated with 1-10th of sulphuric acid, and pour the contents into the porcelain dish, add cold water to make up the volume to about 8 ozs., and complete the operation with the standard permanganate solution.

The process, if conducted as directed, affords very accurate results; upon repeating the determinations there should be practically no variation. The whole time

\* Communicated by Professor Morton.



consumed need not exceed three hours to determine both the chromium and the iron, if the two ignitions are proceeded with simultaneously.

It need scarcely be remarked that fine iron wire or ammonio-protosulphate of iron may, in most cases, be used with greater convenience than borings. I, however, in my own practice, prefer the latter, and for several years past have kept in the laboratory for use a large piece of iron of the kind mentioned, from which, by the aid of a small foot-lathe, I obtain in a moment or two clean unoxidised borings whenever they are needed, and thus have an unalterable standard always at hand.

For dissolving minerals and metals, I constantly use tubes of the kind described, though sometimes of a larger size, preferring them generally to all other vessels for many reasons:—avoidance of loss of substance, convenience of rinsing, expulsion of air while digesting and boiling, carrying out of the laboratory all of the evolved gases by means of the small bent tubes leading into a chamber connected with the main chimney, &c.

When determining iron volumetrically with the permanganate solution, I also always use the cold water acidulated with sulphuric acid, when hydrochloric acid has been the solvent, because with it the final relation is more distinct and the results more constant; besides, if previously prepared in quantity, and cold, it at once reduces the temperature of the hot fluid, and so saves time.—*Journal of the Franklin Institute.*

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ON THE  
ESTIMATION OF PEROXIDE OF MANGANESE  
IN MANGANESE ORES.\*

By JOHN PATTINSON, F.C.S.

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It has long been known that very varying results have been obtained by different analysts in operating upon the same samples of manganese ore, and, very naturally, these discrepancies have been a source of great annoyance to both sellers and purchasers of these ores. In their attempts to find the cause of these differences, Messrs. Teschemacher and Smith were led to the discovery that many manganese ores now in the market contain magnetic oxide of iron. It is said that this substance appropriates a portion of the peroxide of manganese in the ore when the sample is tested by what is known as the iron method of estimation, but not when tested by Fresenius and Will's oxalic acid method; in other words, that the iron process indicates only the *available* amount of peroxide of manganese in the ore, and the Fresenius and Will process the *absolute* amount; and hence, they say, the differences in the results found by the various analysts who use these two methods. This theory may, possibly, be correct in some cases, but it is certain that this is not the only reason why the Fresenius and Will process gives higher results than the iron process in testing certain ores. I have met with several samples of manganese ore containing considerable quantities of magnetic oxide of iron, but I have never yet met with one the magnetic oxide of which was not fully oxidised at the expense of the peroxide of manganese of the ore on being tested by Fresenius and Will's method. Before proceeding further it will be desirable to consider what takes place when the Fresenius and Will test is applied in the presence of protoxide of iron. If the protoxide of iron is in the soluble state it is entirely peroxidised by the oxygen of the peroxide of manganese, and the test indicates a relatively less amount of peroxide in the ore examined. This was proved by the following experiment:—30 grs. of a soft and easily decomposed manganese ore free from magnetic oxide and known

to contain by the Fresenius and Will test 63.36 per cent of peroxide, together with 70 grs. of neutral oxalate of potash, 20 grs. of proto-sulphate of iron containing 3.90 grs. of iron in the state of protoxide, and some water, were treated in the usual way according to the Fresenius and Will method. The percentage of peroxide indicated by the loss of carbonic acid was 53.13, showing that the protoxide of iron in the proto-sulphate had appropriated 10.23 per cent of peroxide. Theory requires 10.21 per cent of peroxide to effect the oxidation of all the iron. The effect is different when the protoxide of iron in the ore is in the insoluble state, as, for instance, when magnetic oxide is present. In this case the protoxide is only peroxidised as it becomes dissolved. It is possible that ores containing magnetic oxide may exist which have their peroxide in a condition in which it is so easily decomposed by oxalic acid that the whole may be decomposed before the magnetic oxide has been at all dissolved. In this case the test would indicate the *absolute* amount of peroxide in the ore. That such a condition may obtain is seen by the following experiment:—25 grs. of an ore similar to that used in the last experiment but containing 63.60 per cent of peroxide by both the iron and oxalic acid tests, together with 60 grs. of neutral oxalate of potash, 5 grs. of very finely-powdered magnetic oxide of iron known to contain 18.6 per cent of iron as protoxide, and some water, were placed in the Fresenius and Will apparatus. On testing in the usual way, the loss of carbonic acid indicated 63.50 per cent of peroxide, or within 0.1 of a per cent of what it was without the magnetic oxide. The magnetic oxide, however, was apparently but very slightly, if at all, affected. A further quantity of sulphuric acid was then added, and heat applied until the solution of the magnetic oxide was completed. The amount of iron existing in the solution was then determined by a standard solution of bichromate of potash. It indicated 1.08 grs. of iron in this condition. The amount in the five grains of magnetic oxide was 0.93 grs. The excess is accounted for by the fact that the oxalic acid in the solution somewhat interferes with the bichromate of potash test for iron.

I have said it is possible that ores of the character described above may exist—ores in which the Fresenius and Will test will indicate the absolute amount of peroxide they contain; but I have never met with such ores. Those I have seen containing magnetic oxide of iron (and some samples have contained a considerable amount) have had this substance so intimately diffused throughout the ore, and have had their peroxide in a condition so difficult to decompose, that the magnetic oxide has been quite dissolved before, or as soon as the complete decomposition of the peroxide has been effected. This was easily proved by testing the resulting solution of manganese and iron for protoxide of iron by means of a few drops of a solution of red prussiate of potash added to the dilute solution. It is obvious that, if after completed decomposition of the ore, the manganese has not peroxidised the whole of the protoxide of the magnetic ore, its presence would be detected by the above test. *In no case have I found any proto-salt of iron in the resulting solutions.* Therefore, in all the cases I have met with, some of the peroxide of the ore has been appropriated to completely peroxidise the magnetic ore, and the Fresenius and Will test, in these cases, does *not* indicate the absolute amount of peroxide contained in the ores.

In my opinion, the more likely explanation of the cause of the discrepancies between the various tests is to be found in the great difficulty with which these hard ores containing magnetic oxide of iron are decomposed in the Fresenius and Will apparatus. In order to effect their decomposition it is necessary to add a large quantity of sulphuric acid, and to apply extraneous heat for a considerable time. It is probable that, during this lengthened heating, steam is allowed to escape with the carbonic acid, and hence a higher amount of peroxide is indicated than is present in the ore.

\* Read before the Newcastle-upon-Tyne Chemical Society, January 27, 1870.



But whichever theory is correct, both lead to the same conclusion that with such hard ores the Fresenius and Will test gives inaccurate results, and therefore should be abandoned. For soft and easily decomposed ores I believe its indications are very correct; but as several of the other class of ores are now in the market, it is necessary to have some process by which the available peroxide contained in all kinds can be correctly determined.

The iron process is one which is now in very general use, and has usually been found to give very good results.

In the paper "On the Estimation of Peroxide of Manganese in Manganese Ores," by Messrs E. Sherer and G. Rumpf, read before the members of this society at their meeting in November last, these gentlemen show that they had obtained inaccurate and irregular results in their experiments with this method as followed by them. They had used pianoforte wire dissolved in a flask with hydrochloric acid, adding the manganese ore in a glass tube, and taking the precaution of keeping an atmosphere of carbonic acid in the flask during the whole process to prevent oxidation by atmospheric air. They attributed the irregularity of the results they had obtained, and correctly I think, to the circumstance that portions of the manganese ore are occasionally floated to the surface of the solution where they evolve chlorine, which escapes without coming into contact with the proto-salt of iron in solution. That this process can be made to yield correct results, by taking precautions to prevent this escape of chlorine, the authors themselves have shown. Fresenius also states in his handbook that the results he obtained by this process agreed exactly with those obtained by that of Fresenius and Will. Messrs. Sherer and Rumpf come to the conclusion that, of the methods they experimented with, Bunsen's gave the most correct results, and that this method was much simpler and shorter of execution than the iron method when the necessary precautions to insure accuracy were employed in the latter process.

In the discussion which followed the reading of this paper I stated that, being aware of the source of error the authors had pointed out, I had, for some time past, used in my laboratory a modification of the iron process by means of which the source of error was avoided, and perfectly accurate and concordant results obtained; and that the modified process was, in my opinion, more easy of execution (requiring less skill and care at the hands of the operator) than the Bunsen method of estimation. In fulfilment of a promise I then made I have now to describe the manner in which I proceed when testing manganese ores by the iron method.

30 grs. of clean iron wire are placed in a 20 oz. flask, along with 3 ozs. of dilute sulphuric acid, made by adding 3 parts of water to 1 of oil of vitriol. A cork, through which passes a tube bent twice at right angles, is inserted in the neck of the flask, and the flask is heated over a gas flame until the iron is dissolved. The bent tube is placed so as to dip into a small flask or beaker containing a little water. When the iron is quite dissolved, 30 grs. of the finely-pounded and dried sample of manganese ore to be tested are put into the flask, the cork replaced, and the contents again made to boil gently over a gas flame until it is seen that the whole of the black part of the manganese is dissolved. The water in the small flask or beaker is then allowed to recede through the bent tube into the larger flask, more distilled water is added to rinse out the small flask or beaker and bent tube, the cork well rinsed, and the contents of the flask made up to about 8 or 10 ozs. with distilled water. The amount of iron remaining unoxidised in the solution is then ascertained by means of a standard solution of bichromate of potash. The amount the bichromate indicates, deducted from the total amount of iron used, gives the amount of iron which has been peroxidised by the manganese ore, and from which can be calculated the percentage of peroxide of manganese contained in the ore. Thus, supposing it were found that 4 grs. of iron remained unoxidised, then

$30 - 4 = 26$  grs. of iron which have been oxidised by the 30 grs. of ore. Then, as

Iron.	Peroxide of Manganese.	Iron.	Peroxide of Manganese.
56	: 44	:: 26	: 20.43

the amount of peroxide in the 30 grs. of ore. The percentage is, therefore, 68.10.

It will be seen, from the above description, that the only differences between this method and that usually described in hand-books are the use of sulphuric acid instead of hydrochloric acid, and the dispensing with the use of a stream of carbonic acid. These alterations, however, enable us to get rid of the source of error indicated by Messrs. Sherer and Rumpf, and also of the somewhat complicated and troublesome apparatus required to supply a stream of carbonic acid.

In order to determine the accuracy of this method, some samples of soft and easily-decomposed manganese ore known to be free from magnetic oxide, were tested by Fresenius and Will's method, and compared with the results obtained by the iron method. The results obtained were as follows:—

By Fresenius and Will's Process.	By Iron Process.
63.36 per cent	63.43 per cent
82.34 "	82.34 "
74.00 "	73.98 "
63.32 "	63.25 "

That by the iron method results can be obtained which agree very closely with each other will be seen by the following statement:—Of 85 samples tested in duplicate by this method 22 were exactly the same in the two results, 54 were within 0.1 of a per cent of each other, 8 were within 0.2 of a per cent, and 1 differed 0.2 of a per cent in the two tests.

The use of sulphuric acid instead of hydrochloric acid not only gets rid of the before-mentioned source of error, but it is also the reason why the carbonic acid atmosphere can be dispensed with. I have ascertained that the solution of iron in sulphuric acid does not oxidise appreciably by exposure to air within any reasonable time; certainly not within the time required to make the test. A sample of manganese ore tested after allowing the iron solution to cool in an atmosphere of carbonic acid, and taking precautions to prevent the admission of air, indicated 63.98 per cent of peroxide by two separate tests. Another portion of the same ore was tested after another portion of iron had been simply allowed to cool in air and to stand one hour before adding the manganese ore. It indicated exactly the same as the sample cooled in carbonic acid, viz.:—63.98 per cent. Another sample, after the iron solution had been allowed to stand two hours exposed to the air, still indicated 63.98 per cent of peroxide. After 19 hours' exposure of another portion the ore indicated 63.96 per cent. There was, therefore, no practical difference in the amount of iron existing as protoxide in any of these solutions. In another experiment a sample of manganese ore, which had indicated 64.45 per cent of peroxide on cooling the iron in carbonic acid, indicated 64.50 per cent after the iron solution had been exposed to the air for six hours, and 64.69 per cent after the iron solution had been exposed to the air during 48 hours. In the last case the iron had become oxidised to a slight extent, but in the case of the iron exposed for six hours little or no oxidation had occurred.

The same results have been repeatedly obtained in other experiments.

The solution of iron in hydrochloric acid oxidises much more rapidly. 7 grs. of iron wire dissolved in hydrochloric acid, and allowed to stand 18 hours exposed to the air in a flask with a cork through which passed an open tube, indicated 6.2 grs. of iron existing as a proto-salt; whilst 7 grs. dissolved in sulphuric acid, and exposed for the same length of time, under the same circumstances, indicated 6.995 of iron existing as a proto-salt.



The kind of iron wire I have found to answer best for these analyses is the kind used by wire-workers, and known as "annealed iron wire." Only the purest qualities of iron are used for wire of this description. I have carefully examined it by comparing it with pure oxalic acid and pure bichromate of potash, as well as by heating it in an atmosphere of chlorine, and find that it is within about 0.1 of a per cent of being absolutely pure. For all practical purposes of testing it may, therefore, be considered pure. There is no difficulty in obtaining it in large quantity and of uniform quality. I have tested wire of this kind of such thickness that 22 wires laid close together cover an inch, and I find it of equally pure quality as that which requires about 85 wires to the inch. I prefer the latter because it is more easily cut and dissolved, and it is more likely to be pure. Pianoforte wire, which is made of steel, will not do, excepting a correction is made for the amount of carbon it contains. I have found wire of this kind which contains only 98.50 per cent of pure iron. The odour of the hydrogen evolved during solution is a good indication of the purity of the iron. With steel wires the odour of carburetted hydrogen is very strong, but with the annealed iron wire it is very slight. In all cases it will be desirable to ascertain the purity of every new batch of iron wire obtained previous to its being used for testing manganese ores. Having once obtained wire of known purity, all future batches may be most easily and correctly tested by comparing the amount of peroxide of manganese, and, consequently of iron, indicated by a certain ore when tested by the new wire with the amount indicated when tested by the wire of known purity. The wire is easily cleaned from all adhering oxide and dirt by passing it a few times through fine emery paper and afterwards through a cloth. It is dissolved by the sulphuric acid in about fifteen minutes. I do not like to use crystals of protosulphate of iron, nor of the double sulphate of iron and ammonia, on account of the uncertainty of their composition. I have never yet met with either of these in so pure a condition as the iron wire. Besides there is no advantage in their use. It is quite as easy to weigh the iron wire as to weigh crystals of protosulphate of iron. I have tried a standard solution of protosulphate of iron, but find it does not keep sufficiently well to make it worth while to use this.

The use of the small flask or beaker in connection with the bent tube is to prevent all loss of iron by its being carried over with the hydrogen and steam. I have, occasionally, found a slight trace of the iron thus carried over through the tube, but this is, of course, all arrested by the water in the small beaker or flask, and is again returned into the larger flask when the tube is rinsed out.

The length of time required to decompose the manganese ore depends upon the hardness of the sample under examination, and this mode of testing thus affords a good indication of the nature of the ore in this respect. Soft ores will be decomposed in a minute or two, whilst very hard ores require fifteen minutes or more. The decomposition can be hastened by adding more oil of vitriol, but this must be done after the iron is dissolved, as the latter does not readily dissolve in stronger acid than that I have mentioned.

The standard bichromate of potash solution I use is made so that 1000 fluid grains will peroxidise 10 grains of iron. It is applied to the diluted solution in the usual way.

If there is reason to suppose that the ore to be tested contains more than about 78 per cent of peroxide, it will then, of course, be necessary to use less than 30 grs. of ore or more than 30 grs. of iron; as these quantities are only intended for ores of a lower percentage than about 78.

In order to facilitate and check the calculation of the percentage results, I have a table drawn up which shows the various percentages in the ores corresponding to every five grains of the bichromate solution, based upon the assumption that 30 grs. of iron and 30 grs. of ore are used.

In conclusion, I have to say that, with respect to the Bunsen method of estimation, it has given me unsatisfactory and variable results so far as I have tried it. I have, however, not yet completed my investigations into this method.

## PROCEEDINGS OF SOCIETIES.

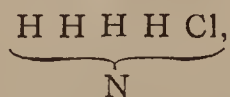
### CHEMICAL SOCIETY.

Thursday, June 2nd, 1870.

Professor WILLIAMSON, F.R.S., President, in the Chair.

MR. W. B. TUSTIN was elected a Fellow.

Professor ODLING, F.R.S., delivered a lecture "*On the Platinum-Ammonia Compounds.*" The lecturer made by way of preface the following remarks:—One atom of platinum combines with four atoms of chlorine to form platinic chloride,  $\text{PtCl}_4$ . In another compound of platinum and chlorine the latter is just one-half of that in platinic chloride, and this platinous chloride may be represented either by the formula  $\text{Pt}_2\text{Cl}_4$  or by  $\text{PtCl}_2$ . Dr. Odling assumes the latter one to be correct, observing, on this occasion, that in chemical theory any assumption may be made, provided it is kept always in mind that it is only an assumption. All platinum-ammonia compounds are produced in the first instance from  $\text{PtCl}_2$ ,—none of them directly from  $\text{PtCl}_4$ . Just like platinous chloride is, through direct combination with chlorine, transformed into platinic chloride, so the platinous ammonia compounds, by direct union with chlorine, form platinic ammonia compounds. This view will at once introduce simplicity in the study of these compounds. The lecturer next proceeded to consider the right manner of expressing the constitution of sal-ammoniac. The decided analogy of this salt with potassium boro-fluoride,  $\text{BF}_3 \cdot \text{KF}$ ; potassium silico-fluoride,  $\text{SiF}_4 \cdot \text{K}_2\text{F}_2$ , and potassium platinochloride,  $\text{PtCl}_4 \cdot \text{K}_2\text{Cl}_2$ , as well as many other evidences, do not permit to represent sal-ammoniac as  $\text{NH}_4\text{Cl}$ , that is



as if by union of hydrochloric acid with ammonia the chlorine would leave its hydrogen in order to combine with nitrogen,—a supposition wholly unwarranted from all the facts known with regard to the affinities of these two elements for one another; the formula of sal-ammoniac must be  $\text{NH}_3 \cdot \text{HCl}$ . From this salt two sets of metallic compounds are derived; in the one set the metal can be detected by the ordinary tests, in the other this cannot be done; the former may be typified by the formula  $\text{NH}_3 \cdot m\text{Cl}$ ,\* the latter by  $\text{NH}_2 \cdot m\text{HCl}$ . An example of the first set is the copper compound,  $\text{NH}_3 \cdot \text{CuCl}$ , from whose solutions the metal is precipitated as sulphide by hydric sulphide, and, with liberation of ammonia, as oxide by an alkali hydrate. An illustration of the second kind of metallic derivatives of sal-ammoniac is the platinum compound  $\text{NH}_2 \cdot \text{PtHCl}$ ; in the solutions of this combination the platinum cannot be recognised by hydric sulphide, or alkali hydrate.

Dr. Odling then continued by drawing his comparison between the manifestations of the atomicity of nitrogen and those of the atomicity of carbon, showing that, like the tetradicity of carbon, is manifested not only in marsh gas and in methyl-chloride, but equally in ethyl-chloride, propyl-chloride, &c., so the pentadicity of nitrogen is not only manifested in sal-ammoniac, but equally in diammonio-argentic chloride, triammonio-cupric chloride, &c. The lecturer,

\* The small letter here, and in the following formulæ, indicates that quantity of a metal which fills the place of one atom of hydrogen.



closed his prefatory observations by declaring his belief in the necessity of studying mineral chemistry in the light of organic chemistry, in order better to understand the reactions and processes of the former. He then gave a short history of the platinum-ammonia compounds, beginning with the so-called green salt discovered by Magnus in 1828, mentioning the salts prepared and described by Gros, Reiset, Peyronne, and others, and finally stating Laurent and Gerhardt's arrangements to classify these compounds. This classification is by no means satisfactory, and having pointed out some of its shortcomings, Dr. Odling concluded his lecture by promising to bring forward at some future meeting his own views on this subject.

## ROYAL INSTITUTION OF GREAT BRITAIN.

*Notes of a Course of Seven Lectures on Electrical Phenomena and Theories.* By Professor TYNDALL, LL.D., F.R.S. (Lecture IV.)

### *Historic Footings, concerning Conduction and the Leyden-jar.*

119. In 1727, Stephen Grey, pensioner of the Charter House, discovered electric conduction. Connecting an end of a wire 700 feet long with a glass tube and supporting the wire on loops of silk, he found that on rubbing the tube the distant end of his wire became electrified and attracted light bodies. He also found that a wire loop did not answer as a support, as the electricity escaped through it; hence arose the division of bodies into conductors and insulators. Grey's observations were written down by the Secretary of the Royal Society the day before his death.

120. In October, 1745, Von Kleist, a bishop of Cammin, in Pomerania, charged with electricity a flask containing sometimes mercury, sometimes alcohol. Through a cork in the neck of the flask passed an iron nail, which was brought into contact with the conductor of an electrical machine. On touching the nail Von Kleist experienced a violent shock.

121. In January, 1746, Cunæus of Leyden received also a shock, and his experiment was repeated by Allamand and Musschenbroek. A wire passed from the conductor of the machine into a flask filled with water. Musschenbroek held the flask in the right hand, the machine was turned, and then with the left hand he drew a spark from the conductor. The shock received was, according to Musschenbroek, so terrible, that he declared he would not receive a second for the crown of France. Musschenbroek observed that it was only the person who held the flask in his hand that felt the shock. Kleist failed to recognise this condition.

122. In Germany the jar is sometimes called Kleist's jar, but more commonly, because of the failure just referred to, the Leyden-jar. The theory of it, and other similar apparatus, was given by Franklin in September, 1747. (See Notes 81, 88, 89, 90.)

123. In 1747, Dr. Watson, Bishop of Llandaff, sent the discharge from a Leyden-jar through 2800 feet of wire, and through the same distance of earth. Subsequently, in the same year, he sent the discharge through 10,600 feet of wire, supported by insulators of baked wood. The experiment was made on Shooter's Hill.

124. In 1748 similar experiments were made by Franklin across the Schuylkill, and by De Luc across the Lake of Geneva.

### *Historic Footings, concerning the Electric Telegraph.*

125. The first proposal of an electric telegraph was made by an anonymous contributor to the *Scot's Magazine* for 1753. Various attempts to apply frictional electricity for this purpose were subsequently made. They culminated in the exceedingly ingenious arrange-

ment of Mr., now Sir Francis, Ronalds, published in 1823.

126. The voltaic pile was described by Volta in a letter to Sir Joseph Banks, written from Como in 1800.

127. Immediately afterwards Nicholson and Carlisle discovered the decomposition of water by the voltaic current.

128. In 1808 Sömmering proposed a system of telegraphy based on the discovery of Nicholson and Carlisle. A similar system was proposed about the same time by Prof. Coxe, of Pennsylvania.

129. In 1820 Ørsted discovered the deflection of a magnetic needle by an electric current.\*

130. The idea of employing the deflection of the needle for telegraphic purposes occurred to the celebrated French mathematician, La Place; the problem was partly worked out by Ampère, and still further advanced by Ritchie, Professor of Natural Philosophy in the Royal Institution.

131. In 1832 Baron Schilling constructed models of a telegraphic apparatus, which were exhibited before the Emperors Alexander and Nicholas.

132. In 1833 Gauss and Weber established an electric telegraph between the Physical Cabinet and the Astronomical and Magnetic Observatories of Göttingen, embracing a distance of nearly 10,000 feet. Faraday's electricity instead of Volta's was employed by Gauss and Weber.

133. Steinheil was requested by Gauss to pursue the subject. To the telegraph he made many highly important contributions and suggestions. In 1837 he had established a system of wires about 40,000 feet in length, connecting various points in the city of Munich and its neighbourhood. The most considerable discovery of Steinheil, and indeed one of the most practically important hitherto made in connection with telegraphy, is that the "return wire" between two stations might be dispensed with, and the earth employed in its stead.

134. In 1834 Wheatstone, by means of a rotating mirror, made his celebrated experiments on the velocity of electricity. In the following year he exhibited one of Baron Schilling's telegraphs in his lectures at King's College.

135. In 1836 Mr. William Fothergill Cooke saw in the lectures of Professor Muncke, at Heidelberg, the performance of a similar instrument. Struck by its obvious practical importance, he devised a system of telegraphy, and, in partnership with Wheatstone, dating from June, 1837, succeeded in introducing the telegraphic system into England.

136. From 1832 to 1836 Morse sought to apply chemical decomposition by the electric current to telegraphic purposes; he abandoned this for his electro-magnetic system devised in 1836. This method consists in stamping, by means of the attraction of an electro-magnet, dots and lines upon a slip of paper caused to move by proper mechanism over the circumference of a wheel.

137. In 1850 the first submarine cable was laid by Mr. Brett between Dover and Calais. It survived only a day. In 1851 another cable was laid down, which proved successful.

138. On the 5th of August, 1858, the submergence of the first Atlantic cable was completed, and messages were sent between England and America. The cable ceased to act on the 4th of September, or about a month after its submersion.

\* In his exceedingly useful little book on the Telegraph, published in Weale's "Rudimentary Series," Mr. Robert Sabine quotes the following remarkable passage from a work on magnetism, published in Paris, by Professor Izarn, in 1804:—"D'après les observations de Romagnési, physicien de Trente, l'aiguille déjà aimantée, et que l'on soumet ainsi au courant galvanique, éprouve une déclinaison; et d'après celles de J. Majon, savant chimiste de Gènes, les aiguilles non-aimantées acquièrent par ce moyen, une sorte de polarité magnétique." The work containing this passage was lent to Mr. Sabine by Mr. Latimer Clark.



139. In 1865 the second Atlantic cable was laid and lost. In 1866 a cable was successfully laid, and in the same year the cable of 1865 was recovered. Messages are now sent between England and America at the rate of fourteen words per minute.

*Phenomena observed in Telegraph Cables.*

140. Davy showed ("Elements of Chemical Philosophy," 1812, p. 154) that a Leyden-battery could be charged with voltaic electricity.\*

141. Dr. Werner Siemens was the first to employ (in 1847) gutta-percha as a means of insulating subterranean telegraph wires. On the 18th of January, 1850, in a paper communicated to the Physical Society of Berlin, he stated that a subterranean wire covered with gutta-percha, and surrounded by the moisture of the earth, behaved like a colossal Leyden-jar. He also found that ordinary telegraph wires charged themselves, though in a much smaller degree than the subterranean wires.

142. In 1838 Faraday predicted the retardation of the electric discharge by its own inductive action. ("Experimental Researches," 1333. "Faraday as a Discoverer," New Edition, p. 89.)

143. In 1854 Faraday experimented with cables at the gutta-percha works of the Electric Telegraph Company. One hundred miles of gutta-percha covered wire were immersed in water, and a second hundred miles of a similar wire were placed in a dry tank. We will call the former the water wire, and the latter the air wire.

144. Connecting one pole of a battery with the earth, and connecting the other pole with one of the two insulated ends of the water wire, on breaking the connection and touching the wire a powerful shock was received;

\* Davy thus describes the celebrated battery with which he made this experiment. The spirit to which the battery owed its birth has not diminished among the members of the Royal Institution:—"The most powerful combination that exists in which number of alternations is combined with extent of surface, is that constructed by the subscribers of a few zealous cultivators and patrons of science, in the laboratory of the Royal Institution (in 1808). It consists of two hundred instruments, connected together in regular order, each composed of ten double plates, arranged in cells of porcelain, and containing in each plate thirty-two square inches; so that the whole number of double plates is 2000, and the whole surface 128,000 square inches. This battery, when the cells were filled with 60 parts of water mixed with 1 part of nitric acid, and one part of sulphuric acid, afforded a series of brilliant and impressive effects. When pieces of charcoal about an inch long and one-sixth of an inch in diameter were brought near each other (within the thirtieth or fortieth part of an inch), a bright spark was produced, and more than half the volume of the charcoal became ignited to whiteness, and, by withdrawing the points from each other, a constant discharge took place through the heated air, in a space equal at least to four inches, producing a most brilliant ascending arch of light, broad, and conical in form in the middle. When any substance was introduced into this arch, it instantly became ignited; platina melted as readily in it as wax in the flame of a common candle; quartz, the sapphire, magnesia, lime, all entered into fusion; fragments of diamond, and points of charcoal and plumbago, rapidly disappeared, and seemed to evaporate in it, even when the connection was made in a receiver exhausted by the air-pump; but there was no evidence of their having previously undergone fusion.

"When the communication between the points positively and negatively electrified was made in air rarefied in the receiver of the air-pump, the distance at which the discharge took place increased as the exhaustion was made, and when the atmosphere in the vessel supported only one-fourth of an inch of mercury in the barometrical gauge, the sparks passed through a space of nearly half an inch; and by withdrawing the points from each other the discharge was made through six or seven inches, producing a most beautiful coruscation of purple light, the charcoal became intensely ignited, and some platina wire attached to it, fused with brilliant scintillations, and fell in large globules upon the plate of the pump. All the phenomena of chemical decomposition were produced with intense rapidity by this combination. When the points of charcoal were brought near each other in non-conducting fluids, such as oils, ether, and oxymuriatic compounds, brilliant sparks occurred, and elastic matter was rapidly generated; and such was the intensity of the electricity, that sparks were produced, even in good imperfect conductors, such as the nitric and sulphuric acids.

"When the two conductors from the ends of the combination were connected with a Leyden battery, one with the internal, the other with the external coating, the battery instantly became charged, and on removing the wires, and making the proper connections, either a shock or a spark could be perceived; and the least possible time of contact was sufficient to renew the charge to its full intensity."

the discharge from the wire was also competent to ignite a Statham fuze. When, after having been in contact with the battery, the wire was separated and connected with a galvanometer, the instrument was powerfully affected.

145. A rush of electricity into the wire was declared by the galvanometer when contact was made; a rush out of the wire was declared when the wire between the battery and the galvanometer was connected with the earth. None of these effects were observed with the 100 miles of air wire.

146. Faraday, like Werner Siemens, rightly explained the effect by likening the cable to an enormous Leyden-jar, the wire constituting the interior, the water the interior coating, with the gutta-percha insulator between them. In fact, the surface of the wire in these experiments amounted to 8300 square feet, while the surface of the outer coating of water was 33,000 square feet. To the charge and discharge of this apparatus the effects observed were due.

147. In a subterranean line of telegraph 1500 miles long were placed three galvanometers: one *a*, at the beginning of the wire: a second, *b*, in the middle; and a third, *c*, at the end, which was also connected with the earth.

148. Connecting the battery with the wire of the galvanometer *a*, that instrument was instantly affected; after a sensible time *b* was affected; and after a still longer time, *c*. It required, in fact, two seconds for the electric stream to reach the last instrument.

149. All the instruments being deflected, when the battery was suddenly cut off at *a*, that instrument instantly fell to zero, *b* fell subsequently, and *c* after a still longer interval.

150. By a brief touch of the battery-pole against *a*, that instrument was deflected, and could be allowed to fall back into its neutral condition before the electric power had reached *b*; *b* in its turn would be affected, and left neutral before the power had reached *c*.

151. In this case a wave of force was sent into the wire which gradually travelled along it, appearing in different parts of the wire at successive intervals of time.

152. It was even possible, by adjusted touches of the battery, to make several successive waves co-exist in the wire.

153. When, after making and breaking contact at *a*, that galvanometer was connected with the earth, part of the electricity sent into the wire returned, and deflected *a* in the reverse direction; here currents flowed in opposite directions out of both extremities of the wire.

154. The effects of induction enabled Werner Siemens and Faraday to explain the widely different velocities assigned by different experimenters to the electric current.

155. To pass through any conductor electricity requires time, the time being directly proportional to the length of the conductor.

156. But in the case of a submarine cable, another cause of retardation comes into play, namely, the charging of the cable; the retardation here is proportional to the square of the length of the cable.

*Artificial Cables.*

157. It was to illustrate points like these and to determine the dimensions to be given to the Atlantic cables, that Mr. Cromwell Varley devised his artificial cables.

158. In one of these cables a resistance equal to that of a real cable 14,000 miles in length is obtained by introducing into the path of the current feebly-conducting liquids instead of metallic wires. The inductive action is obtained by means of condensers of tin-foil. In another artificial cables coils of wire are employed to give the necessary resistance.

159. The arrangement described in Note 81 is a condenser. But those constructed by Mr. Varley are of enormously greater area, the condensing sheets being separated from each other not by plates of glass, but by thin sheets of paper and paraffine. The vastness of the



area and the proximity of the inducing surfaces combine to exalt the effect.

160. When the condensers themselves are charged by a battery, on discharging them they exhibit phenomena similar to those of a Leyden-jar. The shock, spark, and other effects of frictional electricity are readily obtained.

161. A series of fifty condensers, for example, joined "in cascade," that is to say, with the outer coating of each joined to the inner coating of the next, when charged with a battery of 1000 cells yield powerful sparks, and deflagrate wires.

162. If the wire be bent and introduced into a glass of water, the glass is shattered by the discharge.

163. In the 14,000-mile artificial cable are introduced a series of eleven tubes containing the resisting liquid. Into these dip wires. One end of the charging battery is connected with the earth, and the other end can, at will, be connected with the artificial cable. A series of ten galvanometers are placed between the resisting tubes along the artificial cable.

164. When no condensers are employed, on making connection with the battery, all the galvanometers appear to be simultaneously deflected.

165. When a condenser is introduced between each pair of resisting cells (ten condensers in all), the current has to charge each condenser to a certain degree before it can sensibly affect the galvanometer beyond the condenser. Hence, when the condensers are attached, the action on the galvanometers is successive, not contemporaneous.

166. Mr. Varley supposed his 14,000-mile artificial cable divided into sections representing stations in London, at Gibraltar, Malta, Suez, Aden, Bombay, Calcutta, Rangoon, Singapore, Java, and Australia. Supposing an actual cable laid, and galvanometers placed at these stations, the deflections obtained on establishing battery-contact would be successive; they are represented by the deflections of the galvanometers associated with the artificial cable.

167. By varying the resistance and the amount of inductive condenser-surface, a representation of any other cable may readily be produced.

168. Connected with the needle of each of the ten galvanometers is a reflecting mirror, from which a brilliant spot of light is cast upon a screen. When the cable is not in action, the ten spots form a row along the same vertical line; when the battery-contact is made, the successive deflections of the galvanometers are declared by the successive motion of the spots.

#### *Sketch of Ohm's Theory and Kohlrausch's Verification.*

169. I have already spoken (Note 110) of the force which urges forward the electric current (the electro-motive force). The amount of this force may be deduced from the action of the current, when opposed by different resistances upon a freely-suspended magnetic needle.

170. If the wire which carries the current be cut across, the current ceases to flow: the electricity ceases to be *dynamic*; but, at the two ends of the severed wire, we have *static* electricity.

171. By suitable instruments, the amount of this static charge may be determined; it increases with the number of elements of the battery.

172. It is, moreover, proportional to the strength of the current obtained when the wires are re-united.

173. In this way the static charge becomes a measure of dynamical action: electricity at rest is connected with electricity in motion.

174. In experiments on the electroscopic properties of the voltaic circuit, it is necessary that the battery should be well insulated.

175. If the middle point of a wire which connects the two poles of a voltaic battery be connected with the earth, the tension of that point is null. The circuit gradually rises in tension, right and left, to the two poles of the

battery; but on one side of the point we have exclusively positive electricity, while at the other side we have exclusively negative electricity.

176. At equal distances, at opposite sides of the zero-point, the tension is the same.

177. If any other point than the middle be connected at the earth, it becomes the zero-point, right and left of which, as before, we have the two opposite electricities.

178. If the negative end of the battery be connected with the earth, the whole wire shows positive electricity; if the positive end be connected with the earth, the whole wire shows negative electricity.

179. The wire offers a certain resistance to the passage of the current. The battery itself is also in the circuit; and the current has to overcome its resistance also. But the resistance of the battery may be expressed by a certain length of the external wire; when this is done, the sum of the lengths of both wires is called the *reduced length* of the circuit.

180. Given the reduced length of the circuit and the electro-motive force, we can determine, by a simple calculation, the electric tension of every point in the circuit.

181. The circuit through which the current flows may be represented by a horizontal line (called an abscissa); the electric tension at every point of the circuit may be represented by a vertical line (called an ordinate). If ordinates be drawn to represent the electric tensions at a great number of points of the circuit, the line joining the ends of all the perpendiculars will represent the distribution of electric tension in the circuit: the *steepness* of this line also represents what Ohm called the *electric fall*.

182. More strictly, the electric fall is the decrease in the length of the ordinate for the unit of length of the abscissa.

183. The total charge of the wire is expressed by the area of the triangle enclosed by the ordinate, abscissa, and line of fall.

184. The laws of the voltaic circuit, as enunciated by Ohm, have been verified everywhere. The electroscopic state of the circuit has been examined by Kohlrausch, and found to be in strict accordance with Ohm's theory.

185. Ohm assumed the passage of the electric fluid from one section to another of the connecting-wire to be due solely to the difference of electric tension between the two sections. He further assumed the quantity of electricity transmitted to be proportional to this difference of tension; and, from these fundamental assumptions, he deduced the laws of the voltaic circuit.

186. These laws may be briefly stated thus:—

(a). The strength of the current is directly proportional to the electro-motive force.

(b). The strength of the current is inversely proportional to the resistance.

(c). If the wire which unites the two poles of battery be of the same material, and of the same thickness throughout, the "electric fall" is the same throughout the wire.

(d). If the wire be of the same material, but of different thicknesses, the "fall" is steeper on the thin wire than on the thick; the "fall," and therefore the strength of the current, is inversely proportional to the cross-section of the wire.

(e). If the poles be connected by two wires of the same thickness, but of different resisting powers, the electric fall is steepest on the more resisting wire; the "fall" is directly proportional to the specific resistances of the wires.

187. In verifying these laws, Kohlrausch employed a condenser to augment the feeble charges obtained from his voltaic cell; and he held this instrument to be essential. By an exceedingly skilful device, Sir William Thomson has rendered the condenser necessary, and thus greatly simplified the means of demonstration.



## CORRESPONDENCE.

### THE METRIC SYSTEM.

*To the Editor of the Chemical News.*

SIR,—I am glad to see from your abstract of an article from the *Journal für Praktische Chemie*, that a plan for abbreviation of names of the metric system is proposed on something like authority. I should question, however, if the system there proposed will become general, as the use of capitals is inconvenient in writing, and is, so far as I remember, at variance with all our accepted abbreviations, as oz., lb., gr., &c.

My object in writing this letter is not to find fault, but to suggest that some recognised system, either the one referred to or some other, should be adopted in this country. It will not be long, I hope, before the metric system is made compulsory in England, and it is time that symbols for the different terms of the system were established.—I am, &c.,

Midland Institute,  
June 4, 1870.

C. J. WOODWARD.

### ELECTRO-COATING IRON WITH COPPER AND BRASS.

*To the Editor of the Chemical News.*

Sir,—The pithy and able notice of the above subject that you inserted in your report of the last meeting of the Chemical Society, will bear the following remarks from me which were made at the meeting.

The electrolytic brass bath consists of an aqueous solution of equal parts of ammoniac tartrate and potassic cyanide. After receiving cyanide of copper and cyanide of zinc in certain proportions, the oxides of the metals are added to the solution. If upon trial, this solution works with the evolution of hydrogen, a little of the blue ammoniuret of copper is added to the cold bath. The heat that may be used to this bath determines the colour of the brass, and may vary from 60° C. to nearly boiling-point.

The cast-iron calico-printing roll that was exhibited was coated with brass in a brass bath, then transferred to an acid copper bath (cupric sulphate) and coated with copper to 3-16ths of an inch thick.

The weight of the roller was 96 lbs., of the copper coating 29 lbs., and of the roller, when finished, 125 lbs.

The other specimens illustrated the deposition of yellow brass and a deep bronze from the same electrolytic bath.—I am, &c.

74, Brecknock Road, London, N.  
June 2, 1870.

W. H. WALENN.

### TETRABROMIDE OF CARBON.

*To the Editor of the Chemical News.*

SIR,—In the report of the Chemical Society's proceedings in the CHEMICAL NEWS (vol. xxi., p. 223), the following passage occurs:—

"In the above processes, terbromide of antimony may be substituted for the bromide of iodine."

The passage refers to the preparation of carbon tetrabromide. In the CHEMICAL NEWS (vol. xxi., p. 237), a letter appeared, designating this passage as erroneous; the correspondent expressed himself thus:—

"So far from our proposing the action of *terbromide of antimony* on carbon disulphide as a means of preparing tetrabromide of carbon, I am not aware that these two substances have any action upon one another at the temperature specified, 150° C."

Now, the paper on "Tetrabromide of Carbon," by T. Bolas and C. E. Groves, read by one of the authors at the Chemical Society's meeting on May 5th, contains *inter alia* the following:—

"(a). Two parts of carbon bisulphide, 14 parts dry bromine, and 3 parts iodine, were heated together, in a sealed tube, to a temperature of 150° C. for about 48 hours. The contents of, &c.

"(b). Antimony terbromide may be substituted for bromide of iodine in the above process. . . . The above reactions take place, although slowly, at 100° C."

I think there is no further comment required, except, perhaps, to remark that, had the correspondent in vol xxi., p. 237, retained a copy of his scientific paper, he would have spared you much valuable space, and a little time and trouble too.—I am, &c.,

THE REPORTER.

June 7th, 1870.

## MISCELLANEOUS.

**Crystalline Alloy of Zinc and Calcium.\***—The production of a crystalline alloy of zinc and calcium has been observed in the preparation of calcium by the process of M. Caron, in which an excess of zinc was employed. It contains about 95 per cent of zinc and 5 per cent calcium, corresponding to the formula  $Zn_{12}Ca$ . These crystals are small octohedrons with square bases. They are acted upon by water, with the liberation of hydrogen.—*Pogg. Annal.*

**Illustrating the Gain in Weight of Burning Bodies.\***—A very striking mode of demonstrating in the lecture-room that burning bodies increase in weight has been contrived by H. Kolbe. A glass rod is fastened, in a horizontal position, to one arm of a balance. Upon this is fastened a glass cylinder in which a candle is burnt, connected with which, by a glass tube, there is a V-tube for condensing the vapour, a flask filled with lime-water for carbonic anhydride, and two more U-tubes containing soda-lime. The last are connected, by an india-rubber tube, with a Bunsen's pump, by which a steady current of air is drawn through the apparatus. The beam is first counterpoised; as the candle burns away, the arm of the balance to which it is attached sinks down until its progress is arrested by the table.—*Ber. der. Berl. Chem. Gesellsch.*

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

*Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

*Comptes Rendus des Séances de l'Académie des Sciences*, May 30, 1870.

Omitting the papers and memoirs relating to other branches of science, this number contains the following subject-matter bearing upon chemistry and collateral sciences:—

**Physical Phenomena which Accompany the Bursting of Various-Sized Hollow Projectiles (Bombshells and Grenades) by the Freezing of Water contained therein.**—Ch. Mar-

\* Communicated by Prof. Morton.



tins and G. Chancel.—The authors first refer at considerable length to the experiments made in this direction by different authors, from the earliest time up to the present day, and discuss the theories broached on this subject; they next relate their own experiments at length, from which they draw the following conclusions:—The bursting of hollow, cast-iron projectiles, by the effect of the freezing of the water contained therein, takes place when from 30 to 40 per cent of the water is converted into solid ice; this quantity of ice causes a pressure which reduces the total bulk by from 1-45th to 1-35th; the pressures required to cause the bursting for shells of 0.22 metre diameter vary from 430 to 590 atmospheres (each at 15 lbs. pressure to the square inch). This paper gave rise to a discussion, the speakers being General Morin, M. Dumas, and M. Elie de Beaumont, who stated substantially that since the properties of the metal are very much impaired by low temperatures, it would lead to erroneous conclusions to calculate, as the authors of the paper think can be done, the powder charges required for the bursting of projectiles; moreover, a very low temperature has been known to render cast-iron, steel, and wrought-iron so brittle, that it can then be readily reduced to powder.

**Observations on the Melodious and Harmonic Intervals.**—A. Cornu and E. Mercadier.—A paper on acoustics.

**Reclamation of the Priority of the Discovery of Cyanic and Cyanuric Ethers.**—S. Cloëz.—An abstract from various periodicals published since 1857, here quoted to prove the author's just claims to the honour of having discovered the bodies alluded to.

**On Some Compounds Homologous of Tartaric and Malic Acids.**—H. Gal and J. Gay-Lussac.—After referring to the labours of MM. Kekulé, Perkin, and Duppá, on this subject, the authors describe adipomalic, adipotartaric, suberomalic, and suberotartaric acids, obtained by a complicated process, described at great length—adipomalic acid,  $C_{12}H_{10}O_{10}$ ; adipotartaric acid,  $C_{12}H_{10}O_{12}$ ; suberomalic acid,  $C_{16}H_{14}O_{10}$ ; suberotartaric acid,  $C_{16}H_{14}O_{12}$ . The authors exhibit, in a tabulated form, three groups, viz.:—Oxalic, malic, and tartaric groups, each made up of seven different compounds, some of which are, as yet, unknown, and have, therefore, only a hypothetical existence.

**Action of Hydrochloric Acid upon Osseine; New Researches on the Estimation of Osseine in Fossil Bones.**—A. Scheurer-Kestner.—From the author's researches it appears that osseine is soluble in concentrated hydrochloric acid in the cold, but is not acted upon by very weak acid; in order, therefore, to remove that acid, oxide of silver is employed by the author, and, on evaporating to dryness the neutral liquid thus obtained, a white residue is left, which, on ignition, emits the smell of burning horn, but this substance differs altogether from gelatine in its chemical as well as physical properties. The lengthy memoir contains several matters of interest for the determination of the geological age of fossil bones.

**Rapidity of the Absorption of Oxide of Carbon by the Lungs.**—N. Gréhan.—The contents of this paper are interesting to chemists, because the author states that, on heating the blood of persons poisoned with oxide of carbon with sulphuric acid to  $100^{\circ}$ , the gas alluded to is integrally evolved from the blood. The memoir is full of interesting physiological facts, as brought out by experiments.

**Direct Preparation of Pyrotartaric Acid.**—Dr. J. Sacc.—The author dissolves, by the aid of the heat of a water bath, 100 grms. of pulverised anhydrous tartaric acid in 100 grms of acetic acid; the solution is next placed in a retort and heated over a charcoal fire, until the liquid becomes syrupy; on cooling, this thickish fluid deposits pyrotartaric acid in acicular-shaped crystals.

**On Electric Currents; New Observations.**—M. Trève.

**Phenomena of Electrostatic Induction.**—J. Mario.

**Theory of Electric Condensers.**—M. Neyreneuf.

**Description of a Hygrometer Acting by Absorption.**—J. Séverin.

**The Teacher of Descartes.**—A. Georget.—The author, writing from Tours, states that Grandillon was in 1619 a student in a Jesuit college, and did not arrive as Divinity Professor at la Flèche before the year 1626, and that since Descartes had positively before that year left la Flèche, Grandillon cannot have been his teacher there.

**Meteorological Observatory at Montsouris.**—Sainte Claire-Deville.—The author presents to the meeting a report on this institution, and the labours performed there last year and during the early part of this year. The report contains a detailed description of the instruments employed.

*Journal de Pharmacie et de Chimie*, May, 1870.

This number contains the following original memoirs and papers:—

**Thermo-Chemical Researches on the Bodies formed by Double Decomposition.**—MM. Berthelot and Longuinine.—This very lengthy essay is sub-divided as follows—Method of experimenting; acetic chloride,  $C_4H_3ClO_2$ ; acetic bromide,  $C_4H_3BrO_2$ ; acetic iodide,  $C_4H_3IO_2$ ; butyric bromide,  $C_8H_7BrO_2$ ; acetic anhydride,  $(C_4H_3O_3)_2$ . This essay is to be continued.

**Some Experiments with Salts of Chromium.**—A. Commaillie.—It is to be regretted that this interesting paper is too lengthy for full translation, and is so written that it does not admit of any useful abstraction. It contains the following chapters:—Nitric acid and bichromate of potassa; sulphuric acid and bichromate of potassa; hydrochloric acid and bichromate of potassa; iodic acid and bichro-

mate of potassa; oxalic acid and bichromate of potassa; acetic, tartaric, citric, tannic, and benzoic acids, and bichromate of potassa.

**Physical Method for the Determination of those Molecular Groups which are Decomposed by the Electric Current; Application to the Detection of Hydrates Dissolved in Water.**—E. Bourgoin.—This essay is divided into the following sections:—sulphuric acid; nitric acid; caustic potassa; sulphate of potassa; sulphate of soda.

**Presence of Manganese in Milk and in Blood.**—E. Pollacci.—The presence of manganese, as an essential constituent of milk and blood (human, as well as animal), has been known for about 20 years past, but the author gives in this paper some particulars about the method of detection of this metal in the two animal fluids referred to, of which milk contains this metal in the largest proportion; the milk is first evaporated (300 grms. are taken) to the consistency of a paste; this is carbonised by heat in a platinum crucible; the charcoal thus obtained is pulverised, and next completely incinerated; the ash is triturated in an agate mortar and lixiviated with water, in order to eliminate the salts soluble therein, especially chlorides; the residue is treated with very pure nitric acid, and the solution thus obtained is evaporated to dryness and calcined in a test tube; after cooling, a few drops of nitric acid are added, and the contents of the tube again boiled; next, a few grains of puce-coloured oxide of lead are added, and the liquid again boiled; a more or less deeply purplish coloured liquid appears on leaving the tube at rest for a short time, which is due to the formation of permanganic acid. No quantitative researches have, as yet, been made by the author.

**Studies on Grapes; their Products and Vinification.**—J. Le Canu.

**Experiments on the Application of Tin-Foil for the Preservation of Perishable Substances.**—E. Baudrimont.—This lengthy paper contains the record of a series of interesting experiments from which the author concludes that tin-foil, in consequence of its impermeability for water, may serve with great effect to protect various substances from the effects of the atmospheric moisture, as well as acting as a protective against the alterations fruit undergoes by evaporation of the fluids therein contained; tin-foil also protects against the oxidising action of the oxygen of the atmosphere, and may hence serve to keep fatty substances from becoming rancid; while, as proved by an experiment of the author, it may usefully serve in laboratories to wrap up caustic lime (quick-lime), bisulphate of soda, and similar substances, which may thus be preserved for a great length of time without deterioration.

**Metallic Iron obtained by the Electric Current.**—C. Collas.—The author employs a weak solution of chloride of iron, which is decomposed by the aid of a Bunsen battery; perfectly pure iron is thus obtained, which is very friable, highly oxidisable, especially when moisture is present; when this iron, in the state of fine powder, is poured in a bottle, when the atmosphere is very moist, the iron is instantaneously oxidised, water decomposed, and the evolution of hydrogen causes the bursting of the bottle.

*Annales de Chimie et de Physique*, April, 1870.

This number contains the following original papers and memoirs:—

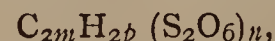
**Experimental and Theoretical Researches on the Equilibrium Figures of a Liquid Mass considered as having no Weight.**—J. Plateau.—The 9th to 12th series of this lengthy memoir.

**Researches on the Different Varieties of Carbon.**—M. Berthelot.—This very extensive memoir is divided into the following sections:—General introduction; description of method for the immediate analysis of the divers varieties of carbon; researches on graphitic oxides; conversion of the same into ordinary organic compounds; investigation of the present state (*état actuel*) of carbon; relation existing between the graphitic compounds and organic substances properly so called; influence of various reagents upon carbon.

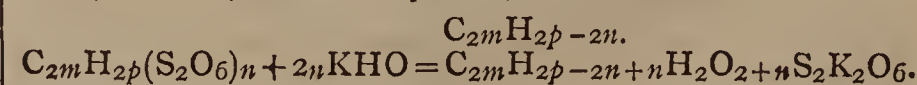
**Oxidation of the Hydrocarbons.**—M. Berthelot.—The main gist of this paper is that the author has found that several hydrocarbons can be directly oxidised without loss of any carbon, and form neutral substances such as aldehydes; this oxidation is effected by chromic acid, dissolved in a small quantity of water; pure ethylen is slowly acted upon, aldehyde being formed— $C_4H_4 + O_2 = C_4H_4O_2$ ; this reaction requires a temperature of  $120^{\circ}$ ; propylen is oxidised at the ordinary temperature— $C_6H_6 + O_2 = C_6H_6O_2$ ; acetylen is also acted upon at the ordinary temperature— $C_4H_2 + O_2 + H_2O_2 = C_4H_4O_4$ .

**Synthesis of Phenol.**—M. Berthelot.—The contents of this paper have been already quoted from another periodical.

**Action of Potassa on the Sulphuric Derivatives of the Hydrocarbons.**—M. Berthelot.—The reactions which hydrate of potassa effects with the sulphuric derivatives of the hydrocarbons, no matter which, may be expressed by the following schematical formula:—Being given an acid,



basic; that acid, treated with potassa, forms a carbide—



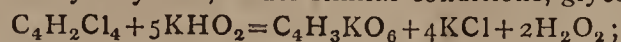
**Synthesis of Acetic Acid by Means of Acetylen.**—M. Berthelot.—The author heats protochloride of acetylen with solution of caustic



potassa in alcohol to 100°, for 10 hours, and thus obtains a large quantity of acetic acid—



that is to say,  $C_4H_2Cl_2 + 2H_2O_2 - 2HCl = C_4H_2O_2, H_2O_2 = C_4H_4O_4$ ; per-chloride of acetylen yields, under similar conditions, glycolic acid—



that is to say,  $C_4H_2Cl_4 + 3H_2O_2 - 4HCl = C_4H_2O_4, H_2O_2 = C_4H_4O_6$ ; treated with aqueous solution of potassa this substance yields oxalic acid— $C_4H_2O_8$ .

*Polytechnisches Journal von Dingler*, first number for April, 1870.

This number contains the following original papers relating to chemistry and collateral sciences:—

**On Naphthylamine Violet.**—Dr. A. Kielmeyer.—From this lengthy paper we learn that the author has investigated this subject thoroughly, and his chief result is that pure naphthylamine yields a fast violet on cotton, if applied in the following manner:—Take starch, 456 grms.; water, 1.1 litre; dry naphthylamine, 118 grms.; water, 1.5 litre; pure hydrochloric acid, sp. gr., 1.1279 grms. Boil this mixture, and add, after cooling—chlorate of potassa, 13.5 grms.; water, 0.3 litre; this compound is printed on, and, after printing, first treated (aged) as is done for aniline black, and next passed through a solution of soda, in order to eliminate the hydrochloric acid set free after that operation and thorough washing, a pure, fast, brilliant violet is obtained.

**Detection of Madder Colours upon Cloth, and by Themselves.**—Dr. W. Stein.—The author boils the cloth with a concentrated solution of sulphate of alumina, whereby a liquid is obtained of reddish colour, exhibiting a golden-greenish fluorescence, due, the author says, to the presence of purpurine; the behaviour of the colouring matters of madder towards sulphate of alumina is, says the author, so characteristic, that that salt may serve as an effective test for these substances; the alizarine may be readily rendered soluble by treating the dye material or dyed cloths with alcohol acidified with hydrochloric acid.

**Extraction of Beet-Root Juice, and its Defecation and Clearing by Means of Sulphuric Acid, Sulphite of Lime, Lime, and Alcohol, as Experimentally carried on at the Beet-Root Sugar Works at Marly, near Valenciennes, France.**—MM. Duquesne and Gil.

**On Dualine, a New Kind of Blasting Powder.**—C. Dittmar.—Dualine is a mixture of cellulose, nitro-cellulose, nitro-starch, nitro-mannite, and nitroglycerine, in various proportions; it is from four to ten times stronger than ordinary powder.

**Aniline Black for Linen.**—Dr. Dingler.—The linen fabric is well shaken in a bath containing a solution of acetate of aniline at 4° Baumé (sp. gr. 1.029); this bath should contain besides—sal-ammoniac, 4 per cent; chlorate of potassa, 4 per cent; nitric acid,  $\frac{1}{2}$  per cent; sulphate of copper, 1 per cent. After the textile fabric has been aged for about three days, it is first passed through a liquid bath, containing ammonia, at 60°, and next washed in a weak soap solution. A very beautiful black is produced.

First May number, 1870.

This number contains the following original papers relating to chemistry and collateral sciences:—

**Electrical Clock.**—Dr. Arzberger.—With several illustrations.

**Metallic Thermometer.**—C. Oechsle.—With woodcuts.

**Manufacture of Cast-Steel from Pig-Iron, by What is Termed Inter-Molecular Combustion.**—S. Jordan.

**Graduation of Oil Testers (Areometers).**—Dr. G. Th. Gerlach.

**Detection of, and on the Injurious Action of, the Vapours of Acetic Acid Mixed with the Air in Some Manufacturing Processes.**—Dr. P. Bolley.—By means of apparatus (not specified), the author found that a cubic metre of air in a calico printing-room, where the ventilation was good, amounted to 7 decigrammes, while, with bad ventilation, as much as 15 decigrammes per cubic metre were detected. The author enters at length into details on the injurious effect of these vapours upon the workmen.

**Manufacture of Naphthylamine.**—M. Ballo.—The author treats nitro-naphthaline with iron and acetic acid, and distils by means of steam; from the distillate the base deposits, on cooling, in crystals.

**Revivification of Animal Charcoal by Means of Brüdenwasser.**—Dr. O. Tech.—By Brüdenwasser is understood the water occurring near Svojsic, in Bohemia; this water contains from 0.013 to 0.026, and sometimes even 0.5 per cent of ammonia.

*Annalen der Chemie und Pharmacie*, April 1870.

This number contains the following original memoirs and papers:—

**Researches on the Salicin Derivatives.**—H. Schiff.—This very lengthy essay contains the following subdivisions—Artificial formation of populine; acetosalicine; preparation of helicine, helicoidine, and nitrosalicylic acid; acetyl and benzoyl-helicine; acetohelicoidine; anilide and toluide of salicylglycoside.

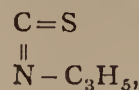
**Sulpho-urea from Persulphocyanic Acid.**—L. Glutz.

**Persulphocyanic Acid Aniline.**—L. Glutz.

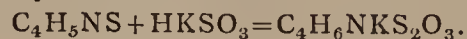
**Pseudosulphocyanogen.**—L. Glutz.

**On Some of the Sulpho-Acids of Benzyl.**—Dr. O. Böhrer.—This lengthy paper contains the following sections:—Benzylsulpho acid; nitrobenzylsulpho acid; monochlorobenzylsulpho acid.

**On a Compound of Essential Oil of Mustard with Bisulphate of Potassa.**—Dr. O. Böhrer.—After briefly stating that essential oil of mustard—



combines directly with several substances, as, for instance, ammonia, sulphide of potassium, and organic bases, the author states that he discovered the compound alluded to—



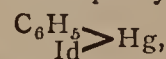
Percentically:—Carbon, 22.01; nitrogen, 6.42; sulphur, 29.55; hydrogen, 2.30; potassium, 17.18; oxygen, 21.91.

**Phenylsulphopropionic Acid, a Derivative from Cinnamic Acid.**—C. Varlet.

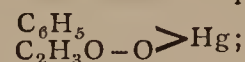
**On Some Compounds of Benzol-Aldehyde, and Primary Monamides.**—Dr. E. Roth.

**Chlorcumarine.**—Dr. H. Bäsecke.

**Mercurodiphenyl.**—E. Dreher and R. Otto.—Mercurodiphenyl is a crystalline material, readily soluble in chloroform, benzol, sulphide of carbon; difficultly so in ether and alcohol; fuses at 120°; sublimes without decomposition; formula— $C_{12}H_{10}Hg$ . The authors treat also of the action of hydrochloric, hydriodic, and sulphuric acids, on this material; its behaviour at higher temperature; action of sulphur upon mercurodiphenyl; action of bromine upon mercurodiphenyl; action of chlorine upon this substance; formation of mercuromonophenylchloride from mercuric chloride and mercurodiphenyl; action of hypochlorous acid upon mercurodiphenyl; behaviour of



and nascent hydrogen; acetomercuromonophenyl,



formic and propionic mercuromonophenyl; behaviour of acetomercurodiphenyl with hydrochloric and sulphuric acids; behaviour of acetomercuromonophenyl towards nascent hydrogen; action of hydrosulphide of ammonium and sulphuretted hydrogen upon acetomercuromonophenyl; behaviour of the last-named body at a high temperature; experiments for the purpose of preparing nitrated mercurodiphenyl; preparation of oxymmercurodiphenyl; preparation of phenyl ether by the action of  $Cl_2O$  upon mercurodiphenyl; action of bromethylen upon mercurodiphenyl; preparation of zinc-diphenyl; copper and iron diphenyl from mercurodiphenyl.

**Direct Conversion of the Fermentation Butyl-Iodide into Trimethyl Carbinol and its Acetic Ether.**—E. Linnemann.

**Notice Concerning the Derivation of the Law of Avogadro.**—K. Zöppritsch.

*Bulletin de la Société d'Encouragement pour l'Industrie Nationale*, March, 1870 (No. 207).

This number does not contain any papers or memoirs relating to chemistry or collateral sciences.

*Revue des Cours Scientifiques de la France et de l'Etranger*, No. 25, 1870.

This number contains:—

**Shape of Comets.**—Dr. Faye.—A lengthy lecture read on this subject at the Sorbonne, and published with a series of diagrams and cuts.

**Asphyxia Produced by the Fumes of Charcoal.**—Dr. C. Bernard.—The instalment of this lengthy lecture on this subject, here published, contains the full and exhaustive description of the chemical and histological alterations the blood globules undergo by the action upon them of carbonic oxide and carbonic acid, and the result arrived at by the eminent author is that the asphyxia alluded to is purely due to physico-chemical alterations of the globules aforesaid.

*Moniteur Scientifique*, No. 322, May 15, 1870.

This number contains:—

**The Increasing Expense of Living.**—G. Ville.—The continuation and end of this lengthy paper, for which see *CHEMICAL NEWS*, vol. xxi. p. 215.

Although not exactly belonging to the subjects treated of by us, we quote the title of:—

**Use of Contre-Vapeur (Steam Backing) in Locomotive Engines Attached to Trains.**—A. N.—A very useful and well written paper on this important subject.

Among the *brevets d'invention* we notice:—

**Manufacture on the Large Scale of Nitrate of Ammonia by the Action of Electricity upon a Mixture of Air and Steam.**—F. A. A. Dufournel.—The eminent editor of this periodical points out very properly, that what is possible as a laboratory experiment will not pay to do on the large scale.



**Tinning of Iron Without the Aid of Heat.**—J. B. A. Daubié.—The chief point of interest in this matter is, that the tinning of iron in the cold cannot succeed at all, unless the bath used for that purpose contains, in solution or suspended, an organic substance like starch or glucose, although no precise scientific explanation of this indispensable condition has been hitherto given; the *breveté* employs the following bath—To 100 litres of water are added 3 kilos. of rye meal; this mixture is boiled for half an hour, and next filtered through cloth; to the clear but thickish liquid are added 106 kilos. of pyrophosphate of soda, 17 kilos. of protochloride of tin in crystals (so called tin-salt), 67 kilos. of neutral protochloride of tin, 100 to 120 grms. of sulphuric acid; this liquid is placed in well made wooden troughs, and serves more especially for the tinning of iron and steel wire (previously polished) for the use of carding machines. When instead of the two salts of tin just named cyanide of silver and cyanide of potassium are taken, the iron is perfectly silvered.

**New and Improved System for the Manufacture of Fuming Sulphuric Acid.**—H. Schemfil.—While the fuming sulphuric acid made at Nordhausen, in Saxony, from previously desiccated sulphate of protoxide of iron, is sold there at from 8 to 12 francs the 100 kilos., that acid as manufactured in France, from an anhydrous bisulphate of soda or potassa, costs from 100 to 140 francs per 100 kilos. The author's plan is to convert iron pyrites, by an expeditious and cheap process, into dehydrated sulphate of iron, and to obtain from this fuming sulphuric acid by a continuous process, the particulars of which cannot be detailed without reproduction of the engravings of the kilns and furnaces devised by the *breveté*, and which are of a very peculiar make.

*Les Mondes*, May 19, 1870.

**Climate of the Haute Savoie.**—Rev. Vaullet.—The author, residing at Annecy, states that he can prove that the mean temperature of the Département of France just named, has perceptibly and steadily increased within the last forty years from 8° to about 10½°; as proof of this statement, he points out that the cultivation of wheat and vineyards is now possible and successful in localities where it was not so forty years ago. Among the causes the author enumerates the cutting down of forests, draining of marsh lands, improvement of roads, and the bringing under tillage of moor and waste lands.

**Effects of the Colouration of the Water of the Mediterranean.**—J. Girard.—According to the author, who has made several journeys on this large inland sea, its peculiar colour, ranging from pale blue, through all shades of that colour to black (viz., when seen from a ship's deck), is entirely due to the mode of reflection of the sun's rays, according to the lower or higher position of that luminary above the horizon, so that at mornings and evenings, when the rays fall more obliquely, and pass therefore through a larger bulk of water, the colour is deepest, viz., at such distances from the shore where the depth of the sea is sufficiently great.

**Discovery of Phosphate of Lime near Charlestown, U.S.**—According to the contents of a letter received by the editor of this periodical, there has been recently discovered a layer of a very pure phosphorite, averaging in thickness from 0.40 to 0.60 metre, over a surface of some 250 hectares; this mineral is used as manure by itself, after having been simply ground up to a fine powder.

*Annales du Génie Civil*, May, 1870.

This number contains a very lengthy paper on—

**Soap and Soap Making.**—L. Droux.—This paper is far too lengthy for any useful abstraction; it contains copious results of analyses of all kinds of soaps, and also full details on its adulterations.

*Annales des Mines*, No. 2, 1870.

This number contains the following original papers relating to chemistry and collateral sciences:—

**Extraction of Lead from its Ores, by means of a Reverberatory Furnace, as carried on at the Works of the Nouvelle Montagne Company, at Engis (Belgium).**—V. Bouhy.

**Mineral Resources of the Ariège.**—M. Muussy.—Second paper on this subject.

**Mechanical Properties of Steel which contains Phosphorus.**—L. Grüner.—When phosphorus is present in quantities of from 0.002 to 0.003, it renders steel more elastic and rigid, increases its resistance to breaking force, without modifying its hardness; but such a steel, even if it contains only little carbon, is wanting in body, and is cold-short.

*Archives des Sciences Physiques et Naturelles, Suisses*, May 15, 1870.

This number contains the following original papers relating to chemistry and collateral sciences:—

**Determination of the Coefficient of Expansion of a Bar of Silver.**—E. Plantamour and A. Hirsch.

**Description of a New Method for Estimating the Calorific Capacity of Fluids.**—E. Wartmann.

**Remarks on a Memoir on the Specific Gravity of Ozone, published by M. O. Wolfenstein.**—J. L. Soret.

*Cosmos*, June 4, 1870.

**General Assembly of the Association Polytechnique.**—This meeting was held on the 29th of May last, under the presidency of M. J. Dumas, Sénateur, &c. This Association has been established for the purpose of giving to the working classes the opportunity of becoming acquainted with physical and other sciences, by means of lectures methodically given, to the number of 200 weekly per annum. Some 20,000 workmen attended last year; and the eminent chairman was authorised by the French Government to communicate to the meeting that this Association is recognised as an establishment of public utility.

**Serious Illness of Professor Liebig.**—V. Meunier.—From a short notice taken from a daily paper, it appears that the celebrated *savant* just named has been seriously ill for some time, having had to undergo twice a dangerous operation on an abscess at the neck. The patient is very feeble, and is stated to have said that he does not believe he will ever recover.

**Decrease of the Rainfall in France.**—S. Meunier.—The author states that it appears more and more certain that the annual quantity of rain is rapidly decreasing; the cause is attributed to the cutting down of forests, and to the fact that no sufficient care is taken to keep the mountains well covered with suitable vegetation, so as to enable their soil to grow trees in abundance.

## NOTES AND QUERIES.

**Tungsten Blue.**—A sample made by the process given in vol. xxi., p. 130, of our journal, has been sent to our office for T. W. S. If he will forward his address we will send it by post.

**Bauxite.**—Can any of your readers inform me where I can purchase the bauxite referred to in vol. iii., p. 203, of "Kerl's Metallurgy." It is composed of 13 to 17 per cent of silica, 60 to 65 per cent of alumina, 4 to 8 per cent of peroxide of iron, and 15 to 17 per cent of water in combination.—J. B. S.

**Self-Raising Flour.**—(Reply to "B.Sc.")—We cannot say for certain, not having had any opportunity of investigating this subject, but it is possible that a small quantity of either dried yeast or, perhaps, good malt powder, is mixed with the material you allude to; both would have the effect of making the flour self-raising upon its being mixed with water.

**Phosphate of Ammonia.**—(Reply to "J. W. M.")—You cannot make this salt direct from bone ash; you will have to extract the phosphoric acid from that substance, and then combine it with ammonia.

**Oxygenated Water.**—(Reply to "J. C.")—The process is patented; you can learn at the Patent Office the particulars you desire, and also whether the patent has expired.

**Chrome-Colour.**—The periodical referred to may be inspected at the Library of the Commissioners of Patents, where you will also find vol. xxi. of *Poggendorff's Annalen*, where, at p. 580, is to be found a full description of Liebig's and Wöhler's process for the preparation of a vermilion-red chrome-colour, for which we also refer you to Gentele's "Lehrbuch der Farben Fabrikation," to be found in the same library.

## MEETINGS FOR THE WEEK.

MONDAY, June 13th.—London Institution, 4.  
Geographical, 8.30.  
TUESDAY, 14th.—Photographic, 8.  
WEDNESDAY, 15th.—Meteorological, 7. Anniversary.  
THURSDAY, 16th.—Royal, 8.30.  
Zoological, 4.  
Chemical, 8.

## TO CORRESPONDENTS.

**A Young Subscriber.**—1. Chloride of nitrogen or a similar chloride.  
2. Your explanation is probably correct.

**J. C. Major.**—Apply to Asher and Co., Bedford Street, Covent Garden. We do not know the price for single numbers.

**John E. Williamson**, in asking a question, desires us to send the reply to his address, as he does not see the *CHEMICAL NEWS*. Surely we are not expected to supply information to those whose interest in chemistry is not sufficient to purchase a copy of our journal. If our opinion is worth anything, it is surely worth fourpence! At all events our time is too valuable to write private letters to such correspondents.

**C. J. W.**—Reinsch's test is the most practically useful for your purpose.

**J. Cox.**—There are several large works in German, but amongst the smaller works one of the most perfect and comprehensive is Wöhler's "Lehrbuch der Anorganischen und Organischen Chemie," 2 vols., 8vo., published at Berlin by Dünker.

**R. W. W.**—We know of no one we can recommend.

**Dr. R. Gerstl, C. H. Wood, and John Pattinson**, are thanked for their communications.



# THE CHEMICAL NEWS.

VOL. XXI. No. 551.

## ON THE DESCENT OF GLACIERS.\*

By The Rev. HENRY MOSELEY, M.A., F.R.S.,  
Canon of Bristol, and Instit. Imp. Sci. Paris Corresp.

GLACIERS do not take their origin in the highest Alpine regions. It is not there that the snow chiefly falls, but on a belt girding them below. This wide belt is divided horizontally into an upper and lower part by the snow-line, at a height of from 3000 to 3300 yards. Above that line snow always lies, and rain very rarely falls; beneath the snow-line the snow disappears every summer, and rains are abundant. It is from this belt about the snow-line that the glaciers are seen emerging. They lie like huge slugs along the descending valleys, swelling themselves out to fill their channels where they are wide, and thinning themselves to pass through the gorges and narrow places in them. They seldom come down to a lower level than 1100 yards. Between this level where they end and the snow-line, 3100 yards high, where they begin, they traverse sometimes a very long space—lying for the most part at a low pitch. The resemblance to a huge mollusk is kept up in *this*, that they move with a strange slow motion, not altogether unlike that of such an animal. The parallel will be complete if we conceive the mollusk to have its tail continually renewed as it withdraws it from under the snow-line, and its head continually melted away as it thrusts it forward below the level of from 1000 to 1400 yards. If we further imagine the steep sides of the valley through which the glacier descends to have similar but smaller glaciers crawling down them to the principal glacier, we shall understand what is meant by tributary or secondary glaciers, which are *thus* placed in regard to the principal ones; having a far greater pitch or slope than they, and flowing into them like tributary streams to a river. The slope of a principal glacier is often as little as 3°, and yet it may move with a velocity of 24 inches a-day. The slope of a tributary glacier is sometimes 50°, and it may not advance more than 4 or 5 inches a-day at the most.† Masses of rock of different sizes, from huge boulders to stones, are constantly broken by the frost from the sides of the valley of the glacier, and are carried slowly down on its back to the level where its head melts away, and there are deposited. These are called moraines. They lie along the course of the glacier in ridges, protecting the ice beneath them from the sun's rays. That ice does not therefore melt as the rest of the ice does, and so it forms a ridge of ice. A moraine is, therefore, a ridge of stones standing on a ridge of ice.

The descent of a glacier is not a descent of the whole together, or bodily like that of a block of stone. There is an internal descent of every particle in the glacier over and alongside of every other particle. If a plane section be imagined to be made across it, the particles of ice passing through that cross-section at any time must be conceived to be all moving at different rates so as to be sliding over and beside one another; the particles at the surface moving faster than those below, and the particles near the centre moving faster than those at a distance from it, exactly as the particles of a stream of water move.

The existence of this differential motion is strikingly seen in what is called the veined structure of glaciers. This veined structure appears first to have been described by M. Guyot, in the year 1838. The following is his account of it, as he saw it on the glacier of Gries, which I translate from the work of M. Huber:—

"I saw under my feet the entire surface of the glacier covered with furrows an inch or two wide, cut in snowy ice, and separated from one another by ridges of harder and more transparent ice. It was evident that the mass of the glacier was here formed of these two different kinds of ice; the former (that of the furrows) was white and melted more rapidly; the other (that of the ridges) was more perfect, crystallised, transparent, and hard. The unequal resistance to melting of these two kinds of ice was the obvious cause of these depressions and elevations. After having followed them for several hundreds of metres I reached a crevasse 20 or 30 feet wide, which, cutting the furrows at right angles, exhibited down to the depth of 30 or 40 feet an admirable transverse section of this structure. As far as my eye could reach I saw the mass of the glacier composed of layers of the [opaque] white ice separated from one another by layers of the transparent ice, the whole forming a mass as regularly stratified as certain calcareous rocks." This is the veined structure of glaciers.

[Canon Moseley's remarks on the differential motion of glaciers, with special reference to the observations and experiments of Forbes and Tyndall, illustrated by diagrams, will be found in the *Philosophical Magazine* for April, 1870.]

The effect of the differential motion in *separating* and *distributing* the parts of a glacier has been shown in various ways. The remains of the guides lost in 1820 in Dr. Hamel's attempt to ascend Mont Blanc were found imbedded in the ice of the Glacier des Bossons in 1863. "The men and their things were torn to pieces and widely separated, many feet. All around them the ice was covered in every direction for 20 or 30 feet with the hair of one knapsack spread over an area three or four hundred times greater than that of the knapsack. "This, says Mr. Cowell, from whose paper read before the Alpine Club in April, 1864, I have made the quotation, "is not an isolated example of the scattering that takes place in or on a glacier; for I have myself seen on the Glacier of Theodule the remains of the syndic of Val Tournache scattered over a space of several acres."

Whatever the force may be which causes the descent of glaciers, it must be chiefly expended in this constant displacement of the particles of the ice over one another and alongside one another, of which the veined structure affords the evidence, and to which is opposed everywhere that force of resistance which is called *shearing* force. By the property of ice called regelation, when any surface of ice so sheared is brought into contact with another similar surface, it unites with it, so as to form of the two one continuous mass. This may be shown by experiment. If a cylinder of ice be placed in an apparatus suitable for the purpose and slowly sheared partly across, the new surfaces continually being brought in contact with one another in the act of shearing will not present the slightest appearance of separation, the ice being *there* as continuous as elsewhere, its molecules entering into precisely the same relations to one another in their new positions as they did in the positions out of which they have been sheared. Thus a slow displacement of shearing, by which different similar surfaces of ice in a glacier were continually being brought into presence and contact with one another, would exhibit all the phenomena of the motion of glacier ice.

The late Principal Forbes calculated that in the Aar glacier the shearing displacement amounts to 13-14ths of the whole displacement of the glacier. The sliding displacement of the whole glacier bodily on its bed is, in comparison with it, unimportant as it regards the expenditure of force requisite to bring it about. The differential

\* Read before the Royal Institution of Great Britain, Friday, May 13, 1870.

† The motion of the Glunberg, a tributary of the Aar glacier, inclined at 30° to 50°, was found by Desor to be 22 metres a-year, while that of the Aar glacier, inclined at 4°, was 77 metres.



motion is the *great* and *characteristic* phenomenon of the descent of glaciers; but it is that, in assigning an adequate cause for which, existing glacier theories seem to me most conspicuously to have failed.

The Swiss philosopher De Saussure was the first to study the descent of glaciers with care, and wrote on it about sixty years ago. He held that glaciers slip down the slopes on which they rest by their weight, just as other bodies slip down inclined planes. This explanation is simple, and was generally accepted as long as it was thought that glaciers slipped down bodily like blocks of stone would, with an equal motion of all their particles; but when the internal motion of their particles upon one another, like that of running water, came to be discovered, and when it was found that the high-pitched tributary glaciers moved slower than the low-pitched principal ones, this theory was brought into doubt, for it was in direct contradiction to these facts.

M. Rendu, the Bishop of Annecy, considered the descent of a glacier to be so like that of a fluid that it was impossible to explain it otherwise than by supposing ice actually *to be a fluid* and not the *solid* thing it seems to be. He was the founder of the celebrated viscous theory of the descent of glaciers, advocated with such remarkable energy, industry, and ability by the late Principal James Forbes, whose various works on glaciers have exhausted the whole field of observation and supply most of the facts on which the true solution of the problem, whenever it is arrived at, must be founded. When, however, at another stage of the inquiry, it came to be discovered by Faraday and Tyndall that ice, when broken up, was capable of being united again by sufficient pressure, so as to become as perfectly solid and homogeneous as it was before, it became evident that supposing a sufficient pressure to be exerted on the glacier, in the direction of its descent, to crush its substance through the contractions and gorges of its channel, and over the irregularities in its bed, it would reform itself and solidify, and become a compact mass again as it was before, when it had passed these obstructions. This is the regelation theory.

At this stage the question had assumed this new form—"If ice be a viscous fluid, according to the viscous theory, is it fluid *enough* to descend by its own weight; or, if it be a solid, according to the *regelation* theory, is it *little* enough solid so to descend?"

If, instead of ice, a glacier were of water, it *would* obviously descend by its weight. The same would be true if it were of oil, or soft mud, or quicksilver, or probably of pitch; but if it were of iron, or of copper, or of lead, it would not descend by its weight only, unless, indeed, these metals were in a state of fusion. A quicksilver glacier would descend by its weight only because it shears easily; a cast-iron one would not, because it shears with difficulty. There must, therefore, exist a relation between the shearing force and the weight of a given volume of a glacier, so that it may just descend by its weight only. Now, it is possible to investigate mathematically what that relation is.

I have made that investigation.\* I have founded it on this well-known law of mechanical philosophy, that "The aggregate *work* of the forces which produce the displacement of a body or a system of bodies (however related) must, at least, equal the aggregate work of the resistances which oppose that displacement."

The resistances opposed to the displacement of a glacier are—1. Those which oppose themselves to the shearing of one surface of ice over another, which is continually taking place throughout the whole mass by reason of the differential motion. 2. The friction of the superimposed laminae of ice upon one another, which is greater in the lower than the upper. 3. Abrasion of the ice on the bottom and sides of the channel of the glacier. If it descends by its weight only, then the work of its weight in its descent through any distance must at least equal the sum of the works of all these resistances. It is, of

course, impossible to represent this relation mathematically in respect to an actual glacier having a variable direction and an irregular channel and slope; but in respect to an imaginary one having a constant direction and a uniform channel and slope, it is possible. I have made that calculation, and it results from it that the unit of shear in ice (that is, the force necessary to make one square inch of ice shear over another square inch) must not be more than  $1\frac{1}{2}$  lb. that a glacier may descend by its weight only. If the unit of shear in ice be more than that, then the glacier cannot descend by its weight only on a slope like that of the Mer de Glace. But it is a great deal more than that. It requires from 60 lbs. to 120 lbs. to shear one square inch of ice over another square inch. The ice of the Mer de Glace cannot, therefore, descend by its weight only; it does not shear easily enough. It must be ice of about the consistency of soft putty to descend by its weight only, for that substance shears with a pressure of from  $1\frac{1}{2}$  lbs. to 3 lbs. per square inch.

Ice, therefore, if it be fluid, is not fluid *enough*, and if it be solid, it is *too* solid to descend by its weight only. There must be some other force to help it down besides its weight—certainly forty-five times greater, and possibly ninety times. The imaginary case, to which alone these calculations apply, differs, indeed, from the actual case of a glacier in this respect, that it is straight and uniform. But if its weight be insufficient to bring a glacier down a straight and uniform channel, much more will it be so to bring it down a crooked and variable one. This result is directly opposed to the viscous theory and to that known as the theory of regelation, both of which attribute the descent of glaciers to their weight as the only cause. It reveals the existence of some other force. What is it?

(To be continued.)

## ANALYSIS OF THE KHETTREE METEORITE, WITH AN ACCOUNT OF ITS FALL.

By D. WALDIE, F.C.S.

THE meteoric stone, of which the analysis is given in the following pages, fell near Khettree, Rajputana; and the sample was supplied to me by Mr. W. Stotesbury, of the Topographical Survey, who at the same time communicated an interesting account of the circumstances of the fall, of which he was to some extent personally cognisant. The account I shall give in his own words, from his letter to me.

"Whilst employed in making a topographical survey of a portion of Shekawattie, in Rajputana, in February, 1867 (I forget the exact date),\* I was out at work one morning at about 9 o'clock. I was suddenly startled by a loud report, resembling that of a cannon, at Khettree, the seat of a petty prince, about 11 miles distant to the south of the place where I was then working. The first report was followed by two more, louder than the first, but a little to the east of the place where I imagined I heard the first report; these three were succeeded by a regular roll, resembling musketry heard at a short distance. The day being a beautiful bright one, and no clouds to be seen anywhere, and also seeing no stones falling, I did not know what to make of this (to me) strange atmospheric phenomenon. I immediately communicated the above facts to the Editor of the *Delhi Gazette*, asking to know what these strange reports in the air meant, and the cause thereof. The day after I had posted the letter, I was informed by some villagers that, the day before, they heard the reports, and that a shower of aërolites had fallen, and that the stones had been seen by them. Mr. Robert Todd, a friend of mine, and in the same survey-

\* Mr. Stotesbury has since found, from an entry in one of his books, that the date was January 19th, 1867.

\* *Phil. Mag.*, May, 1869.



party as myself, seeing my query in the *Delhi Gazette* regarding these reports, wrote to the Editor of the above paper, informing him that they were caused by a fall of aërolites: he was at that time working about 10 miles to the east of me, and describes the reports, &c., the same as I have mentioned already. The showers of stones, as I learned afterwards from the villagers, amounted to about forty, which fell chiefly near a village called Saonlod, 3 miles to the north of Khettree, in Shekawattie, Rajputana (lat.,  $28^{\circ} 9' 45''$  N.; long.,  $75^{\circ} 51' 20''$  E.; and about 90 miles S.-W. of Goorgaon, near Delhi).

"The natives, not knowing what to make of these stones, and being just as superstitious as, if not more than, all natives of India, put it down the vengeance of some offended deity: they therefore set about gathering all the stones that they could find; these they afterwards pounded down to powder, and scattered this to the breeze, &c., so as not to let the vengeance of the offended god redound on them. No sooner did I hear of the fall of the stones, and ascertained the exact locality, than I sent all the Sowars attached to my camp to scour the country round about the place, with the intention of procuring as many of the stones as possible. I was very nearly too late; as, between them all, they only managed to get the piece I sent down to you, and that by a promise of a large reward. I cannot fully describe to you the fear of the inhabitants of the villages adjacent to where the stones fell, and their amusing and queer descriptions as to their ideas of the cause and nature of the aërolites.

"I am sorry I had not an opportunity of viewing one of the stones before they had been broken by the foolish villagers, as I should have then been able to give you the real size, &c., of them; but, from descriptions given me by the more respectable class of natives, I should say the stones were about the size of a 24-pounder shot, quite round, with a blackish appearance on the outside, and impregnated with a sulphurous smell. They fell with such velocity that they sank 2 or 3 feet into the ground, a sandy soil. The men who gave me these descriptions I summoned and questioned them myself. Of course, as is natural with natives, I received all sorts of communications regarding the fall of the stones; but they are only as foolish as they are untruthful, so it is no use my giving them you. The descriptions I have now given you may be relied on, as they are collected, by myself, from personal interviews with the more informed and respectable class of natives, such as Mahajans, Pataels, and the Raj officials; and I only kept those descriptions that tallied with others I had previously received from others."

The stone is partly of a light bluish grey colour, partly of a much darker grey; in some places the two portions lying in contact like two strata, in others nodules of the one imbedded in the other. The broken surface is studded over with metallic particles, many of them having a bright metallic lustre; and there are also observable, by aid of a lens, spots of a yellowish or brown colour, from oxidation of the iron, and granules of a greenish-yellow colour and translucent appearance, probably olivine. Spherules of earthy matter are also visible, and round cavities in which others have been imbedded. When coarsely powdered, the spherules are more visible; and, when more finely powdered and examined under water with the lens, the lighter portion of the stone exhibits a considerable quantity of a nearly white crystalline matter, the particles of which are tolerably uniform in size, mixed with small angular fragments of black, brownish, opaque, and greenish-yellow, translucent minerals, and irregularly-shaped but rounded particles of iron. The dark grey portion exhibits the same appearances, but with a much larger proportion of dark-coloured, earthy minerals. The particles of the iron, having resisted trituration, now appear much larger than the others. After the metallic matter has been removed by acid, the remainder seems to consist of the white, fine, crystalline matter observed in the original light grey portion of the stone, mixed with a few

black particles. The stone is not very hard, and, but for the particles of iron, is not difficult to powder.

It is covered with a dark grey, nearly black crust, cellular on the surface, and corrugated somewhat longitudinally, and of about one-third of a millimetre thick.

Many of the older analyses of meteorites are very imperfect, being very defective even in the detection and estimation of the chemical constituents. Of late, the chemical examination has been much more complete, and improvements have been made in their proximate analysis, obviously a matter of the greatest interest. The most recent of these investigations have been the very valuable ones by Daubrée and Meunier, of the Museum of Paris, chiefly on meteoric iron, for the separation of the uncombined metal from the sulphides and phosphides and other constituents. As my attention had not been previously directed towards the analyses of meteorites, I did not notice their papers so early as would have been desirable, and lost time and labour in the first processes employed. The separation of the earthy minerals is still very imperfect, and there are no very obvious means available for this purpose.

The general plan of analysis followed was to act upon the powdered stone first by acid solvents, and afterwards to extract the silica set free from combination by boiling with solution of carbonate of soda. The matter resisting the action of these agents was attacked in the usual way, by fusion with alkaline carbonate, or with baryta. The boiling with carbonate of soda was troublesome: the solution could not be filtered perfectly clear; it always carried with it a small portion of undecomposed mineral in a fine state of division.

The constituents were those generally found in meteoric stones of similar appearance. The part soluble in acids consisted chiefly of silicate of magnesia and iron, with interspersed particles of nickel, iron, and sulphide of iron. The part insoluble in acids was also chiefly silicate of magnesia and iron, but with a much larger proportion of silica.

The analysis of several different portions showed a certain variety of composition. Thus the insoluble matter varied from 39.5 to 42.6 per cent of the whole. In the soluble portion, the total amount of iron varied from 24.7 to 27.7 per cent in all states. As the particles of iron differ very considerably in size, it follows that, as the proportional quantity of these varies, so must that of the other constituents.

But treatment with acids did not show the amount of iron in the free state, as distinguished from that in combination; iodine answered better, but acted partially on the sulphide of iron, as well as on the uncombined metal. Recourse was had to the solvent lately proposed by Meunier—solution of bichloride of mercury, which dissolves the uncombined metal only: the mercurous chloride produced was removed by a current of chlorine, according to his plan, and metallic mercury by heat; the remaining mineral was then treated by hydrochloric acid, preferably with addition of some nitric acid. From the amount of iron found in this acid solution, a proportion was deducted as combined with the sulphur and phosphorus; the remainder was calculated as oxide. The sulphide of iron was taken as  $\text{Fe}_7\text{S}_8$ , troilite, as contended for by Meunier. The whole of the nickel is supposed to be in the state of alloy with iron, though probably part exists as sulphide.

An attempt was made to separate the light-coloured portion of the stone from the dark, so as to compare their composition in the principal points. The light-coloured portion was got free from the dark, but the dark remained still mixed with a considerable portion of the light-coloured. The differences observed will be pointed out after the results of the general analysis have been given.

A little phosphorus was found, and is supposed to exist in combination with iron, 1 equiv. to 3 equivs. iron,—Schreibersite.



The results of analysis are as follows:—

Dried at 212° F.

Iron .. .. .	16.98	91.54
Nickel .. .. .	1.26	6.79
Cobalt .. .. .	0.21	1.15
Chromium .. .. .	0.10	0.52
Nickel iron .. .. .	— 18.55	100.00
Iron .. .. .	2.69	51.54
Sulphur .. .. .	1.76	33.71
Iron .. .. .	0.65	12.46
Phosphorus .. .. .	0.12	2.29
Troilite and Schreibersite .. .. .	— 5.22	100.00
Magnesia .. .. .	13.76	39.11
Lime .. .. .	0.68	1.93
Soda .. .. .	0.09	0.26
Protoxide of iron .. .. .	7.51	21.35
Alumina .. .. .	0.41	1.17
Silica .. .. .	10.73	30.50
Loss (removed by carbonate of soda with the silica) .. .. .	2.00	5.68
Earthy matter soluble in acids .. .. .	— 35.18	100.00
Magnesia .. .. .	10.04	23.70
Lime .. .. .	1.69	4.00
Soda (with trace of potash) .. .. .	0.78	1.84
Protoxide of iron .. .. .	3.65	8.62
Oxide of chromium .. .. .	0.40	0.95
Alumina .. .. .	1.36	3.22
Silica .. .. .	24.44	57.67
Earthy matter insoluble in acids .. .. .	— 42.36	100.00
	101.31	

The earthy matter insoluble in acid is augitic in character, and closely resembles, in composition, the minerals tremolyte and actynolyte, except that above two-thirds of the lime in those minerals is replaced in this by protoxide of iron. It also contains chrome-iron to the extent of 1.39 per cent, or 0.59 per cent of the entire stone.

The earthy matter soluble in acids is somewhat similar in composition to chrysolite or peridot, but contains a larger proportion of magnesia and iron. There is probably a much greater mixture of different minerals than in the case of the insoluble portion.

There is a little chromium soluble in acid, and also soluble in iodine, at least partially. I have supposed it to be a constituent of the nickel iron alloy.

Several portions which had been treated with acids (in which, consequently, uncombined iron could not be estimated) contained, in the soluble portion, more silica than is given in the above analysis (about 2 per cent more). The proportion of matter insoluble in acid, in these cases, was about 39.5 per cent of the whole stone.

Attention was directed, as already stated, to the differently-coloured portions of the stone. Analysis gave the following results:—

	Light-coloured.	Dark-coloured chiefly.
Specific gravity in small pieces	3.743 ..	3.612
„ again wetted ..	3.763 ..	3.704
„ in powder ..	3.818 ..	3.729

#### Constituents Soluble in Acids.

	Light-coloured.	Dark-coloured chiefly.
Uncombined iron .. ..	17.77 ..	16.20
Sulphur .. ..	1.75 ..	1.77
Magnesia .. ..	13.65 ..	13.88
Protoxide of iron .. ..	6.67 ..	7.76
Cobalt .. ..	{ all, or nearly all.	{ none, or nearly none.

The portion insoluble in acids differed little in the two kinds. It will be observed that the principal difference is in the relative proportion of uncombined and oxidised iron, the dark portion containing most oxide of iron, the light part containing most uncombined iron, and all, or almost all, the cobalt. The higher specific gravity of the light-coloured portion accords with the greater quantity of metallic iron it contains. The state of oxidation of the iron was not experimentally determined, but was assumed to be that of protoxide, in accordance with the analyses given of similar terrestrial minerals. The cause of difference between the loss of weight sustained by boiling the mineral after the action of acids and the weight of the silica obtained appears to depend upon small quantities of other constituents, removed by the carbonate of soda in solution or in very fine states of suspension. In one experiment, made with great care, the difference of weight was nearly accounted for in this way in alumina and oxide of iron, lime, and magnesia. In this case, the loss of weight by carbonate of soda was 12.015 grs.; the silica obtained 11.563 grs., loss only 0.452 gr. Of the above constituents, there was obtained 0.315 gr., leaving only unaccounted for 0.137 gr. from 100 grs. of the stone.

I have compared its composition with that of other stones, as given in Buchner's "Treatise on Meteorites," Leipzig, 1863, and find it bears a pretty close resemblance to that of "Blansko," (Brünner Kreis, Mähren), November, 1833, and that of "Insel Oesel," in Russia, April, 1855, and a still closer one to that of "Klein-wenden," by Nordhausen, Prussia, of September, 1843.

## ON TWO PECULIAR PRODUCTS IN THE NICKEL MANUFACTURE.

By JOSEPH WHARTON.

### I.

SEVEN years ago, when I was about to commence operations at Gap Nickel mine and furnace, I noticed among the fragments left by my predecessors a piece of nickel matt which contained occasional plates apparently of a metallic substance, tough, pliable, and elastic; these plates were about as thick as fine writing paper, from  $\frac{1}{16}$  inch to  $\frac{1}{8}$  inch wide, and about twice as long. No chemical examination of them was made except a slight qualitative examination showing the presence of nickel, iron, and copper.

Having on several occasions subsequently noticed some tendency to a similar appearance in the matt, I gave directions that, when it should next be observed, a close examination should be made, after the extinction of the furnace producing the peculiar matt, of the solid mass which always remains in the bottom of the furnace.\*

This solid mass consists in part of lumps of ore, flux, and fuel of the first charge, which reached the hearth imperfectly melted or consumed and so remained, and in part of accretions from the thoroughly fused matt which, as the furnace worked, formed a pool over and enclosing those lumps.

The cavities of such a mass seemed to me favourable for the production of crystals when a tendency to crystallise existed.

Last midsummer very interesting groups of crystals were, in fact, found upon breaking up one of these masses to fit it for re-melting; they were so small, however, that, except for search being made in consequence of the matt of that furnace having exhibited the plates above named, the crystals would probably not have attracted attention.

\* It should be explained that the furnaces in question are small upright blast furnaces, in which the ores of Gap Mine (Nickeliferous Pyrrhotite with 2 per cent Ni and Co), previously roasted, are smelted for the first time, the product being a matt containing about 12 per cent Ni and Co, with about 4 per cent Cu.



Some of these crystals are cubical, with a bright metallic lustre, the groups closely resembling miniature geodes of galena; others are minute octahedrons, arranged in spiculæ, and in dendritic or plumy forms, resembling the fern-like aggregations of zinc crystals which I sometimes found in the prolongs of my spelter furnaces at Bethlehem, Pa.

These crystals are very tough, and are highly magnetic. A spicula of the octahedrons can be bent many times without breaking, and one which was floated upon water, after being lifted a few times by a magnet, pointed steadfastly to the north, and showed attraction and repulsion to the poles of a magnet just as a steel magnetic needle would under like circumstances.

A specimen of the octahedral crystals, and a specimen of the granular or almost crystalline solid matter to which they were attached, were submitted for analysis to the chemist of my establishment with the following results:—

Crystals.				Granular.	
Cu .. ..	1.85	0.466		1.74	0.438
Ni and Co ..	25.22	6.837		28.20	7.640
Fe .. ..	64.10	36.622		62.50	35.861
S .. ..	8.90	43.925		7.60	43.939
	100.07	1:4.93		100.04	1:5.78

The subordinate column in each case shows the quantity of S which would be requisite to form, with the metals found, the compounds  $\text{Cu}_2\text{S}$ ,  $\text{Ni}_2$  and  $\text{Co}_2\text{S}$ ,  $\text{FeS}$ ; the ratio, below it, is that of the S found to that thus calculated.

If we conceive the copper to exist as  $\text{Cu}_2\text{S}$ , we then have 89.32 parts Fe, Ni, and Co in combination with 8.43 parts S: taking then the average atomic weight of the metals according to the proportions found, as 56.85, the atomic ratio of the metals to that of the sulphur is as 31.4 to 5.27, corresponding very closely to the formula  $\text{R}_6\text{S}$ .

Should the copper be included in the average, we get the figures R 32.00, S 5.56, indicating, though less accurately, the same formula.

## II.

Desiring last year to make, in a granulated form, an alloy consisting of  $\frac{3}{4}$  nickel,  $\frac{1}{4}$  copper, I caused a mixture of the oxides of those metals in the due proportions to be heated in closed crucibles with charcoal in a blast furnace; by this means reduction and fusion resulted, and the fused alloy was poured into water at a high white heat.

Among the granulated metal were found large numbers of hollow spheroids varying in size from peas to large chestnuts, many of them imperfect and torn, but many of them tolerably regular in shape, one side being usually bright and smooth, while the other was rough and pimpled.

As, upon crushing these with a hammer, the anvil was moistened, I examined a considerable number of them, and found that they were nearly full of water, so that the water distinctly rattled within them when shaken, and showed itself in quantity when the larger spheroids were carefully broken. Fluid metal, poured white-hot into water, had formed metallic bulbs filled with water.

For several days I carried some of these bulbs in my pocket, occasionally rattling the water in them, before the manner of their formation occurred to me. My first idea—that drops of metal falling upon the water were flattened by the blow, and that the edges then instantly clasped together and became welded, enclosing water within their grasp—was obviously untenable, for the eye could detect no seam or crevice, and besides, how could water exist as a liquid shut in by walls of this refractory alloy at a welding heat? Apple dumplings are formed in a manner somewhat similar to that, but these bulbs were not so formed.

The true solution is doubtless this: The metal when poured was in a state of ebullition, was giving off gas; not probably metallic vapour, but perhaps carbonic oxide.

The separate globules into which the thin stream divided upon entering the water, were each emitting gas when contact with the water produced upon their surfaces an impervious film of solid or pasty metal. The continued evolution of gas in the fluid interior of such globules could have then no other effect than to distend the globule into a bulb, whose upper side might well be pimpled by the effort of tiny gas bubbles in the pasty shell to escape upward, while similar tiny bubbles working upward in the crust of the under side would reach the interior cavity, thus leaving the lower surface smooth and bright.

Multitudes of incipient globules were, of course, torn and distorted by reason of the internal gas finding a vent, and, of course, any which were rent must necessarily be filled by the water in which they were plunged. Those, however, in which the eye found no aperture were doubtless filled, after the coldness of the external water had so contracted the heat-rarefied gas as to produce an approximate vacuum within the bulb, by the slow imbibing of water through minute pores to supply that vacuum. That such pores existed was shown by the fact of the bulbs all, in time, losing their water by exposure to a desiccating atmosphere.

Not all the pots of metal produced, when poured, such globules, for not all were in the fit state of ebullition.

The nature of the disengaged gas might perhaps have been determined, if a sufficient quantity had been collected by breaking the globules under a receiver, but this was not done.—*Am. Journ. Sci.*, xlix., 365.

Philadelphia, March, 1870.

## INVESTIGATION OF FLAME-TEMPERATURES, IN THEIR RELATIONS TO COMPOSITION AND LUMINOSITY.\*

By Profs. B. SILLIMAN and HENRY WURTZ.

### I.

#### CALORIFIC POWERS OR EFFECT OF GASES.

THESE subjects lie, in our belief, at the very basis of the true theory of the phenomena of luminiferous gases, and have practical bearings that can scarcely be overrated.

In fact, our studies of the subject have led us in the direction of the general conclusion that, all other conditions being equal, the *temperature* in a given flame is the main factor of luminosity. This, however, may as yet be regarded merely as an hypothesis, in consequence of the imperfection of our present means of actual experimental demonstration of the temperatures of flames. It is an hypothesis, nevertheless, which is in general accordance with known facts. By the spectroscope, for example, which can recognise only luminous rays, we find that the higher the temperature the greater the number of these luminous rays. The recent results of Frankland upon the development of luminosity by increased pressure, in flames which are non-luminous under atmospheric pressure, are in accordance with this view; increase of temperature necessarily following increase of pressure.

Very vague views have been rife, even among chemists, with regard to the temperatures of luminiferous flames. Some have been satisfied with believing crude hypotheses—such as that the heat-power of a flame is always proportional to the *density* of the gas or vapour undergoing combustion, or that it is proportional to the *amount of oxygen consumed* by a given volume of the gas, and so on. This latter hypothesis has been one of very common acceptance. A view which is even now entertained by some

\* Read to the American Association at Salem. Communicated by the Authors.



skilful chemists (than which, however, nothing, as will be shown below, could be more fallacious) is that those individual gaseous compounds which impart the highest luminosity, under ordinary conditions, are also the most productive of heat.

The admirable researches of the great gas-chemist, Bunsen, of Heidelberg, placed in our possession, some years ago, the means of computing, at least with approximate accuracy, the heat of flames of gases of known compositions. Few, however, have properly and successfully applied Bunsen's method in practice. We consider it quite time that these methods should be introduced to the knowledge of gas-engineers, in forms available to them.

Bunsen's *formulæ* for these computations are based upon the actual experimental determinations of the *total* amounts of heat developed by the combustion of different pure combustible gases with pure oxygen made by Favre and Silberman, and upon Regnault's determinations of the specific heats of gaseous products of combustion.

It is not to be maintained that Favre and Silberman's numbers are strictly correct, but they are doubtless approximate, and at least proportionately correct among themselves; at any rate, they are the best data we have. Those employed here are included in the following table. They are usually given in the text-books for equal *weights* of the gases; but we have reduced them to the standard of equal *volumes* also, as more suitable to our present purpose. This reduction is made simply by multiplying the equivalents for weights by the densities as given in the third column.

TABLE I.

Total caloric equivalents

	Of equal weights.	Of equal volume.	Densities on scale of hydrogen = 1.
Carbonic oxide	34,462° C. ..	34,462° C. ..	1.0
Hydrogen ..	2,403° ..	33,642° ..	14.0
Marsh gas ..	13,063° ..	104,504° ..	8.0
Olefiant gas ..	11,858° ..	166,012° ..	14.0

The meaning of this table is simply that equal weights of water would be heated by the several gases to temperatures proportional to the numbers in the first column when equal *weights* of the gases are burned, and proportional to those in the second column when equal *volumes* are burned.

A cursory glance at the figures in the second column of this table might seem to justify the notion hitherto entertained by many of the comparatively-low calorific powers of hydrogen and carbonic oxide; and it was doubtless as a consequence of such a comparison as this that statements have been put forth and widely accepted among American gas-engineers to the effect that the weight of water heated from the freezing to the boiling-point by 1 cubic foot of the four main components of illuminating-gas, respectively, is as follows:—

Hydrogen .. ..	2.22 lbs. water
Carbonic oxide ..	2.16 ..
Marsh gas .. ..	6.17 ..
Olefiant gas .. ..	10.74 ..

The figures here being obviously about in the same ratio as those in the second column of Table I. Several most grave errors, however, are here involved. To get at the true relative calorific effects of the above gases, when burned in the open air, in heating water below its boiling-point, deductions must be made, not only for the *specific heats* of the products of combustion of the gas, but also (more important still) for the specific heat of the *nitrogen of the air* required to burn the gas. In fact, when we consider that, for each volume of oxygen required to burn a given volume of a gas, about *four volumes* of nitrogen must be heated up to the temperature of the

flame, it becomes easy to conceive, what is actually the fact, that, within certain limits, the waste of heat due to this cause alone counterbalances altogether the advantage that would be supposed to result from the crowding of combustible matter into so condensed a form as in the illuminating hydrocarbons. An inevitable result of our investigations of this matter is that the heating powers of the flames of pure hydrogen and pure olefiant gas, even when used to the greatest advantage, to heat water below its boiling-point are almost or quite identical.

In this discussion we have occasion to use the numbers representing the specific heats of but *three* gases—the three, namely, which remain after complete combustion, *steam*, *carbonic acid*, and *nitrogen*; as we must assume that, in the hottest and most luminous zone or shelf of the flame, there is no oxygen in excess to be heated. These three numbers are, according to Regnault's latest determinations, for equal weights of—

Steam .. ..	0.4805
Carbonic acid .. ..	0.2163
Nitrogen .. ..	0.2438
(Liquid water being .. ..)	1.0000

This means that the amounts of heat which would raise 1 lb. of water and steam *to the same degree* are in the ratio of 0.4805 for the pound of steam, and 1 for the pound of water.

#### Calculation of the Calorific Effect of Hydrogen Burning in Air.

Let us take first the simplest case possible, that of hydrogen with exactly the right admixture of pure oxygen to burn it, which, by Table I, develops a total heat of 34462° C., that is, would heat a certain weight of *liquid* water to this temperature. In order to find the actual amount of heat contained in the products of combustion, we must first take into account the fact that 1 lb. of hydrogen burns to *nine pounds* of steam, and then obtain the ratio between the above number, 34462, and the amount of heat necessary to heat nine times the weight of steam, that is, nine times the specific heat of steam. Calling the total residual heat in the produced steam  $x$ , we have the simple proportion—

$9 \times (\text{sp. heat of steam} = 0.4805) : 34462 :: (\text{sp. heat of water} = 1) : x$ ;  
Or—

$$x = \frac{34462^\circ}{4.3245} = 7969^\circ \text{ C.}^* = 14376^\circ \text{ F.};$$

a number which, we may add, represents the *maximum* of heat capable of being imparted to *liquid water* by the flame of Hare's oxyhydrogen blowpipe.

Still, we have by no means here the actual temperature of the free or open flame of Hare's blowpipe, which is generally *lower* than this figure, as we have not yet taken into account the "latent heat," or heat of vapourisation, of the 9 lbs. of steam formed. The centigrade temperature necessary to convert 1 lb. of water into steam being 537°, to get the *actual temperature* of the oxyhydrogen flame we must modify the above equation, so that—

$$x = \frac{34462^\circ - (9 \times 537^\circ)}{4.3245} = 6851^\circ \text{ C.} = 12364^\circ \text{ F.};$$

which is the temperature actually possible in the flame of the compound blowpipe, *were the combustion instantaneous and complete*.

When hydrogen gas burns in *air*, however, as has been before stated, another deduction of enormous amount must

\* Bunsen, in his "Gasometry" (English edition of 1857, p. 242), gives this number as 8061° C., the difference being due to the use by him of a different number for the specific heat of steam, namely, 0.475, apparently an earlier determination of Regnault. Bunsen makes here the singular oversight of regarding this figure as the temperature when "the gases can freely expand, as is the case in an open flame," overlooking the correction necessary in this case for the *latent heat of steam of combustion*, as is explained in the text above.



be made from the above figures, due to the heat required to expand the nitrogen. This is obtained simply by adding to the divisor, as above, the weight of the nitrogen of the air employed, multiplied by its specific heat. The weight of the nitrogen in air = 3.318 times the oxygen; so that the latter of the above equations becomes—

$$x = \frac{34462^\circ - (9 \times 537^\circ)}{4.3245 + (8 \times 3.318 \times 0.2438)} = 2744.5^\circ \text{C.} = 4972^\circ \text{F.}$$

[We have here a full explanation of the extraordinary rate of degradation of illuminating-gas by admixture of air, which we have discussed elsewhere. The nitrogen of such air is not merely a diluent, or even a mere deductive, quantity; its specific heat is an actual *divisory* function in diminishing the flame-temperature.]

This, then, is the actual temperature to which the flame of hydrogen gas burning in the atmosphere might attain to, supposing complete and instantaneous combustion. If it is desired to obtain, instead, the total calorific effectiveness, as in heating water below its boiling-point (in which case the latent heat of the steam of combustion becomes also available), the above expression is changed by simply omitting the subtrahend in the numerator—

$$x = \frac{34462^\circ}{4.3245 + 6.4714} = 3192^\circ \text{C.} = 5778^\circ \text{F.}$$

#### Calculation of Calorific Effect of Carbonic Oxide Burning in Air.

As the product of combustion is here solely carbonic acid, no latent heat of steam enters, and the calorific effectiveness is the same under all circumstances in air. In the numerator, we substitute, of course, the calorific equivalent of 1 volume of carbonic oxide from Table I; and, in the denominator, for the specific heat of 9 lbs. of water, that of 22 lbs. of carbonic acid, being the weight of the latter formed by the combustion and combination of 14 lbs. (weight of a volume of carbonic oxide on the hydrogen-scale by third column of Table I) of carbonic oxide with 8 lbs. of oxygen. The number for the specific heat of nitrogen is the same as before; and the equation is now—

$$x = \frac{33642^\circ}{(22 \times 0.2163) + 6.47} = 2996^\circ \text{C.} = 5425^\circ \text{F.}$$

#### Marsh Gas and Olefiant Gas.

In these two cases, we have, as products of combustion, both carbonic acid and water; and, therefore, when the calorific effects are sought for, we have not only the latent heat of steam entering as a subtrahend into the numerator, but also into the denominator, as divisors, all three of the specific heats of steam, carbonic acid, and nitrogen.

Then, as 8 lbs. of marsh gas consume 22 lbs. of oxygen, and produce 22 lbs. of carbonic acid and 18 lbs. steam; and, as 14 lbs. of olefiant gas consume 48 lbs. of oxygen, producing 44 lbs. of carbonic acid and 18 lbs. of steam: the equations for the calorific powers of their flames in air become:—

For marsh gas—

$$x = \frac{104504^\circ - (18 \times 537^\circ)}{(18 \times 0.4805) + (22 \times 0.2163) + (32 \times 3.318 \times 0.2438)} = 2414^\circ \text{C.} = 4386^\circ \text{F.}$$

And for olefiant gas—

$$x = \frac{166012^\circ - (18 \times 537^\circ)}{(18 \times 0.4805) + (44 \times 0.2168) + (48 \times 3.318 \times 0.2438)} = 2743^\circ \text{C.} = 4970^\circ \text{F.}$$

When the deduction for the latent heat of the steam of combustion is not made, the results in these two gases are considerably higher, as will be obvious from mere inspection of the formulæ.

We shall now give, in tabular form, all the results of

our calculations of the calorific powers, when burning in the air, of the four gases we have to deal with.

TABLE II.

For equal volumes of the gases burning in air.	Calorific effects in heating liquid water.		Calorific effects above 100° C.	
	C.	F.	C.	F.
Hydrogen { (Sp. heat, HO = 0.4805)	3192°	5778°	2744°	4971°
{ (Sp. heat, HO = 0.4750)	3204°	5799°	2755°	4991°
{ Mean .. .. .	3198°	5788°	2749°	4980°
Carbonic oxide .. .. .	2996°	5425°	2996°	5425°
Marsh gas (sp. heat, HO = 0.4805)	2660°	4820°	2414°	4386°
Olefiant gas (sp. heat, HO = 0.4805)	2916°	5481°	2743°	4970°

#### Computation of Calorific Effects of Mixed Gases.

The above table renders the calculation of the calorific effects of any given gaseous mixture whose centesimal composition is known a matter of extreme simplicity. It is only necessary to obtain the sum of the multiples of the percentage of each component gas into its calorific capacity, as given in the Table, and divided by 100.\*

To serve as examples of these modes of computation, we here cite, in tabular forms, the results of some analyses of a number of gaseous mixtures, made by us during the past winter (1868-9). [These analytical results, it may be remarked, possess points of novelty and importance, both scientific and practical, which will bring them up again, hereafter, in other connections. They are here placed on record.]

Table 3 gives the results of two analyses of gaseous mixtures obtained by passing steam, *superheated to incandescence*, upwards through a mass of *anthracite coal* heated to a high degree in a clay retort of a novel construction, according to what is now known as the "Gwynne-Harris" or American hydrocarbon-gas system. In this table the results are calculated without carbonic acid and sulphuretted hydrogen, which, with traces of nitrogen, and sometimes of oxygen, are found in the unpurified anthracite gas.

TABLE III.

#### Analysis of Anthracite Hydrocarbon-Gas.—By Silliman and Wurtz.

	1.	2.	Mean.
Hydrogen .. ..	60.43	59.32	59.87
Carbonic oxide ..	35.44	37.14	36.29
Marsh gas .. ..	4.13	3.54	3.84
	100.00	100.00	100.00

In Table 4, column 1 gives the results of the analysis of the street-gas served out at this period by the New Haven Gas-Light Company, made from Westmoreland coal, enriched with about 6 per cent of Albertite; column 2 the mean of four analyses of the completed hydrocarbon-gas made by us at Fair Haven during the same time, by combining gas from the same Westmoreland coal (with 10 per cent of Albertite) with half its volume of the anthracite gas. Columns 3 and 4 are obtained from 1 and 2 by centesimal reduction, after deduction of the illuminant ingredients, being what we propose to designate as the non-illuminating *substrata* of illuminating-gases.

\* Prof. Bunsen, in the masterly discussion of the subject presented in his "Gasometry," not having in view the exact object we propose, has used a train of reasoning and a mode of formulation of some complexity, to follow which requires some little mathematical skill; part of his objects having been to construct a *formula* so general and comprehensive as to cover the direct computation, from any gaseous mixture independently, of its special calorific intensity. We have here aimed at so simplifying as to bring the whole subject within the capacity of all. Our above tabulation of the individual gaseous components, as a starting-point, seems, to us, to accomplish this most effectually, so far as illuminating-gases are concerned.



TABLE IV.

Gas Analyses.—By Silliman and Wurtz.

	New Haven city gas. 1.	Fair Haven hydrocar- bon gas. 2.	Substratum of New Haven gas. 3.	Substratum of Fair Haven gas. 4.
Hydrogen ..	43.58	46.77	46.79	50.27
Carbonic oxide ..	2.14	9.56	2.31	10.27
Marsh gas ..	47.42	36.71	50.90	39.46
Illuminants ..	6.86	6.96	—	—
	100.00	100.00	100.00	100.00

Table 5 gives the results of the computation, from our *formulae*, of the calorific powers of these five gaseous mixtures, for communicating temperatures both above and below that of aqueous ebullition. We should remark that we have been obliged to regard the volumes of *illuminant hydrocarbons* as representing olefiant gas solely, both because we have no certain data as to their real nature, and particularly because, if we actually knew or should assume the nature of the hydrocarbon-vapours present, still we have no experimental calorific equivalents, as we have for olefiant gas, from which to start in such a computation. We have reason to believe, nevertheless, that the errors thus introduced are not important in amount.

TABLE V.

	Weights of water equally heated below boiling; by equal volumes.	Weights of water equally heated above boiling; by equal volumes.	First column reduced to New Haven gas = 100.	Second column reduced to New Haven gas = 100.
Anthracite gas ..	3100	2828	104.2	109.2
Substratum of the New Haven street-gas ..	2917	2581	98.1	99.6
Substratum of the Fair Haven hydrocarbon gas ..	2962	2640	99.6	102.0
New Haven gas (with the illu- minants assumed = olefiant)	2974	2592	100.0	100.0
Fair Haven gas (with the illu- minants assumed = olefiant)	2959	2647	99.5	102.1

## Conclusions.

Some of the practical conclusions to which we are of necessity compelled by the results of the above investigations are somewhat remarkable; so that we feel diffident regarding them. It is, however, always safe to follow the leading of Truth, however astray she may conduct us from our preconceived notions.

From Table 2, it is apparent:—

1. That, of all known gases, the highest calorific effects, under ordinary atmospheric conditions, are obtainable from *carbonic oxide*, whose calorific value, above 100° C., is about 3000° C.

2. That, in absolute calorific value, below 100° C., in the atmospheric medium, *hydrogen* surpasses its volume of any other gas, giving a temperature of about 3200° C.

3. That for all modes of application—that is, for producing both high and low temperatures—the total maximum calorific effectiveness of carbonic oxide is a *constant quantity*.\*

4. Compound condensed submultiple volumes of hydrogen, like that in marsh gas, have much *less* total calorific value in air than their volume of free hydrogen.

5. Condensed compound submultiple volumes of gaseous carbon, like that in olefiant gas, have no greater total calorific value in air, below 100° C., than their own volume of carbon gas in the form of carbonic oxide; while above 100° C. their value is even considerably less.

\* Metallurgists, especially, will appreciate the suggestive import of the truths presented under the first and third heads; here enunciated, as we think, for the first time. It is to be noted that all the above effects belong to the *maximum* kind, and, of course, reach their development only under the most favourable conditions in each case respectively.

## TANTALUM AND NIOBIUM.\*

By Prof. ALBERT R. LEEDS.

In a long and interesting review of the great investigation of tantalum and niobium which occupied the last twenty years of H. Rose's life, Rammelsberg re-computes the *formulae* according to the modern theories of chemistry, and shows that Rose's mistakes were not so much in the analyses as in the *formulae* he deduced from them.† Blomstrand and Marignac have already pointed out that Rose fell into the error of regarding as a chloride what they demonstrated to be an oxychloride.

In order to obtain metallic tantalum, Berzelius heated tantalum-potassic fluoride with potassium: on treatment with water, there remained behind a heavy, black powder. H. Rose employed 3 parts tantalum-sodic fluoride and 1 part sodium: here, also, remained a heavy powder, which contained a considerable quantity of sodic bitantalate. Marignac reduced tantalum-potassic fluoride with aluminum: by treatment of the regulus with chlorhydric acid, a grey, crystalline powder remained behind of the composition  $Ta_2Al_3$ . Marignac did not succeed in preparing pure tantalum; and, up to the present time, it is unknown. The impure tantalum obtained by Rose conducted electricity very well; changed, with incandescence, on heating in the air, into tantalic acid; and was attacked by no acid except fluorhydric, and by that very slowly. The atomic weight of tantalum, as determined by the decomposition of tantalum-potassic fluoride into tantalic acid and potassic sulphate, was 182. Tantalic chloride was obtained by heating tantalic acid and carbon in an atmosphere of chlorine. It melts, according to Deville, at 241.6° C., and volatilises entirely, forming a crystalline sublimate. According to the same chemist, it fumes in the air, expels HCl, and covers itself with tantalic acid. Its formula, as derived by Rose from the amount of chlorine it yielded, is  $TaCl_5$ . To prepare pure tantalic acid, it is recommended to decompose tantalite by fusion with potassic bisulphate, and to fuse the salts which separate out with acid fluoride of potassium. The difficultly-soluble tantalate is allowed to crystallise out of the solution of the double fluorides, and is decomposed by heating with sulphuric acid, &c. It is white; when heated, faintly yellow; and has a formula,  $Ta_2O_5$ . Its numerous salts are arranged, by Rammelsberg, in five series, corresponding to the different stages of saturation of the acid.—*Journal of the Franklin Institute*.

## CORRESPONDENCE.

## ASSAY OF MANGANESE ORES.

To the Editor of the Chemical News.

SIR,—In his paper on the "Estimation of Peroxide of Manganese in Manganese Ores" (CHEMICAL NEWS, vol. xxi., p. 267), Mr. Pattinson points out a probable source of error in the Fresenius and Will method of testing manganese.

Speaking of hard ores containing magnetic oxide of iron, he says—"In order to affect their decomposition it is necessary to add a large quantity of sulphuric acid and to apply extraneous heat for a considerable time. It is probable that during this lengthened heating steam is allowed to escape with the carbonic acid, and hence a higher amount of peroxide is indicated than is present in the ore."

That this could not have been the cause of the higher results obtained by this method, in the experiments given in the paper on the "Estimation of Peroxide of Manganese

\* Communicated by Professor Morton.

† *Journ. für Prakt. Chem.*, 1869, p. 334.



in Manganese Ores" (CHEMICAL NEWS, vol. xx., p. 302), is evident from the fact that in the three tests there given, extraneous heat was in no case applied to the apparatus, and, therefore, the boiling-point was not reached.

I have since tested three different samples of manganese by the Bunsen and by Fresenius and Will's method, which, by the latter, gave results from 1 to 1½ per cent higher than by the former, and in testing them by Fresenius and Will's method I took the precaution of connecting the apparatus with weighed chloride of calcium tubes during the heating and drawing of air through the apparatus, and found after repeated heating to the boiling-point, no increase in the weight of the chloride of calcium tubes, and no decrease in the weight of the apparatus. The higher results obtained in these cases by the Fresenius and Will's method cannot, therefore, be due to the escape of steam.

I have tried the method described by Mr. Pattinson, and obtained results agreeing very closely with each other.—I am, &c.,

EDWARD SHERER.

June 11th, 1870.

## THE ENGLISH COMMERCIAL SODA-TEST.

To the Editor of the Chemical News.

SIR,—My attention has lately been drawn to a strange error made by some analysts in attempting to apply the English commercial test for soda to samples of alkali, soda-ash, &c., the result of which error is to make the test indicate from 1 to 1½ per cent more soda than the sample contains by the proper English test. It is well known that this (the English soda-test) had its origin in the early days of the soda trade—when chemists believed the equivalent of soda to be 32, and that of carbonate of soda 54; and that, consequently, test acid was made so that 40 parts of sulphuric acid neutralised 54 parts of carbonate of soda equal to 32 of soda. This method of testing has always been, and still is, used by the soda trade throughout England; and it is a custom well understood by both buyers and sellers. It indicates 0.66 per cent more soda in a 50 per cent alkali, than the rigidly-correct test based on the new equivalent 31 would indicate. It is certainly desirable, for the sake of scientific accuracy, that the correct equivalent, 31, should be used in testing; but, seeing that manufacturers have expended their capital in plant, and made their contracts for their various materials on the understanding that a product containing a certain percentage of soda would be obtained, and, seeing that there are other commercial customs of the trade still in force, which tell as much against the manufacturer as the test does in his favour—such, for instance, as that of not charging for fractions of percentages, it is more the province of an association like the Alkali Manufacturers' Association, than that of an analytical chemist, to make alterations in trade usages affecting such vast interests. Certainly, if any alteration be made at all by chemists, it should be made in the direction of scientific accuracy, and not in the contrary direction, as in the case to which I have referred. The error, I find, arises in this way: The test-acid is made so as to indicate the exact amount of soda according to the new and correct equivalent 31—that is, that 40 parts of sulphuric acid should neutralise 53 parts of carbonate of soda, equal to 31 parts of soda.

To convert the results obtained by this test-acid into the English commercial soda-test, it is incorrectly assumed that the 31 parts of soda are equal to 32,—in other words, that the 53 parts of carbonate of soda contain 32 parts of soda. This is where the error lies; for, according to the correct English test, 54 parts of carbonate of soda, and not 53, contain 32 of soda; and, therefore, by the English test, 53 parts of carbonate of soda contain only 31.41 of soda. By thus mixing up the old and the new systems of equivalents, a sample of soda-ash which, by the correct English test, contains 50.66 per cent would be returned

as containing 51.61 per cent of soda. A sample of caustic soda which, by the correct English test, would contain 75.0 per cent of soda would, by this erroneous method, indicate 76.4 per cent. It is only necessary to point out this error in order that it may be avoided and guarded against by any of your readers interested in the buying and selling of alkalies.—I am, &c.,

JOHN PATTINSON.

Newcastle-upon-Tyne,  
June 7th, 1870.

## MISCELLANEOUS.

**Double Sulphide of Potassium and Iron.\***—By heating an intimate mixture of 5 parts of sulphur, 5 of potassic carbonate and 1 part of fine iron-filings, C. Preiss has succeeded in forming a double sulphide of potassium and iron, which crystallises in red needles, has a metallic lustre, and resembles in appearance potassic permanganate. Its formula is  $\text{KS,Fe}_2\text{S}_3$ .† The same compound has been obtained independently by R. Schneider, who also has formed, by the replacement of iron by bismuth, the analogous compound,  $\text{KS,Bi}_2\text{S}_3$ .—*Pogg. Ann.*

**Application of Mica as a Substitute for Bronze.\***—A means has been found of greatly increasing the value of mica, by converting it into a colouring material. The mica is reduced to small pieces in a stamping mill, digested with chlorhydric acid, cleansed by washing and sorted by sieves into sizes. The mica scales so prepared have a beautiful vitreous lustre, a silvery appearance, and bear in commerce the name of Brocade Crystal Colours or Mica Bronzes. The advantages of these brocades over the common metallic ones are:—(1). They contain no unwholesome substance. (2). They possess a metallic lustre like the metallic brocades, and much surpass them in splendour. (3). Brown, blue, black, green, and red colours of rare brilliancy can be obtained, which is not the case with the metallic brocades. (4). They are not dimmed by sulphur vapours. The analyses by Dr. Cech and Schneider show that the colouring matter of the rose-brocade is cochineal; that of carmine is fuchsine; bright red, fuchsine and Havanna brown; violet, Hofmann's violet; bright blue, Berlin blue; dark blue, probably impure aniline blue or Girard's violet; light and dark green, a mixture of aniline blue and curcuma; gold, curcuma; silver, the mica alone, &c.—*Journ. für Prakt. Chemie.*

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopaedic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

*Comptes Rendus des Séances de l'Académie des Sciences*, June 6, 1870.

This number contains the following original papers and memoirs relating to physico-chemical and collateral sciences:—

**Action of Water upon Iron, and of Hydrogen upon the Oxide of Iron.**—H. Sainte-Claire Deville.—(Second paper on this subject.) The author describes at length the phenomena observed when iron is heated to 150°, 265°, 440°, 860°, 1040°, and, lastly, to the highest temperature porcelain can bear without becoming soft—first, leaving the tension of the vapour constant; and, secondly, varying it. Curiously enough, the author finds that, the higher the temperature iron is heated

\* Communicated by Professor Morton.

† *Journ. für Prakt. Chemie*, cvii., p. 10.



to, the less it decomposes water; in chemical parlance, the author says, we should say that the affinity of iron for the oxygen of water decreases with the increase of temperature. The lengthy memoir contains a series of tabulated results of experiments; and the author winds up with a metaphysical discussion on the real signification of force.

**Reduction of Nitrous Acid by Metals.**—E. Fremy.—The author, referring to his former paper on this subject, now states that the oxy-ammonia discovered by M. Lossen, and also obtained by the author as the result of the decomposition of nitrous acid, was now prepared on purpose, by causing a mixture of chlorhydric acid and tin to act upon the nitric ether of wood-spirit; and, on studying its properties, he finds these to agree with what has already been said. The author then describes the action of sodium-amalgam upon a nitrate, which is thereby first converted into a nitrite, and this, in its turn, into oxy-ammonia, nitrogen, and protoxide of nitrogen, which gas, however, remains in solution in the alkaline liquid.

**Optical Properties of Benzyl, and of some Substances belonging to the Camphor Groups, in the Crystalline State and in Solution.**—M. Des Cloizeaux.—In this lengthy memoir, the author describes a series of experiments, the chief results of which are that benzyl and periodate of soda possess, when in solid crystalline state, strongly-marked rotatory powers, and are devoid thereof in the state of solution. Quartz, chlorate, and bromate of soda act the same. Sulphate of strychnia possesses rotatory powers, in crystalline as well as in dissolved state; while ordinary camphor, patchouli camphor, camphor (stearopten) of oil of mint, Borneo camphor, terecamphen, and monochlorhydrate of turpentine, possess rotatory power when in solution, but not in crystalline state.

**Displacement of the Rays observed in the Solar Spectrum.**—A letter to M. Fizeau on this subject from the Rev. Father A. Secchi, S.J.

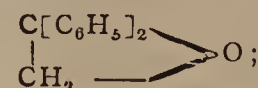
**Rectification of some Dates relating to the Rev. M. Grandillon's Life.**—A. Georget.—The author states that the Rev. M. Grandillon was Professor of Natural Philosophy at Orleans in 1617; from 1619—1623, he was successively Professor of Logic, Metaphysics, and Divinity at La Flèche; in 1624 and 1625, Professor of Divinity at Paris; 1626 and 1627, Prefectus Studiorum and Concionator at Bourges; from 1628—1630, Rector at Alençon, where he died on the 29th of October, 1631. He was a Roman Catholic priest, and a member of the Order of Jesuits before 1614, and was, about that year, Reader on Philosophy at Paris. From a foot-note added to this notice, we learn that the dates alluded to are the authentic figures extracted from the official documents in the possession of the Society of Jesus.

**Insalubrity of the Water of the River Croult, and on the means of Preventing its Pollution by the Refuse from Starch Manufactories.**—M. Gérardin.—Only the title is given of this paper.

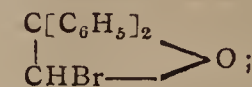
**Formation of Blood Globules.**—Dr. Felz.—The author states that, from some observations made by him, these globules are formed also outside of the blood vessels, but are not then coloured. He quotes, as instances, the presence of white blood globules in the tissue of the cornea of the eye, cartilage, and similar tissues.

freezing at  $-10^{\circ}$ , and not boiling without decomposition. When combined with water, this substance forms a solid body,  $C_3H_2Cl_2Br_2O + (OH_2)_4$ , containing 20.17 per cent of water of crystallisation.

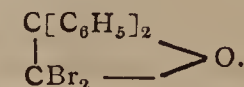
**Toluylen Oxide.**—H. Limpricht.—The author describes at length, and with the use of a lengthy series of complicated formulæ, the constitution of—Toluylen oxide—



bromated toluylen oxide—



double bromated toluylen oxide—



The bromated body is a solid, fusing at  $50^{\circ}$ , crystalline, and giving off bromine at  $160^{\circ}$  when heated along with water, or at  $150^{\circ}$  when heated along with alcoholic potassa solution. The bibromated compound is also a solid, crystallising in prismatic-shaped crystals, and fusing at  $110^{\circ}$ . The author refers to, and to some extent corrects, the statements made by Dr. Zinin in reference to the constitution of these compounds and their connection with other chemical compounds.

**Preparation of Hydrated Hydrobromic Acid.**—H. Topsøe.—After referring, at some length, to the various modifications made by several authors, among which Drs. Gladstone, Kekulé, Mène, and others, in the preparation of the acid referred to, the author states that, according to his researches, the following mixture suits the purpose best:—Amorphous phosphorus, 1 part; bromine, 10 parts; water, 15 parts (of the latter fluid, a portion is to be placed in the receiver). On distilling this mixture, a colourless fluid is obtained, which becomes gradually stronger (containing more anhydrous acid) until the boiling-point reaches  $125^{\circ}$ . The acid obtained at that temperature has a sp. gr. of 1.49, and contains 48.17 per cent of anhydrous hydrobromic acid.

**Tabulated Forms Exhibiting the Specific Gravity and Percentage Composition of Hydriodic and Hydrobromic Acids at Various Temperatures.**—H. Topsøe.—The strongest hydrated hydriodic acid which can be obtained boils at  $127^{\circ}$ , contains 57.75 per cent of anhydrous hydriodic acid, and its equivalent is 221.7. The equivalent of the strongest hydrated hydrobromic acid just alluded to is 168.2.

**Chemical Constitution of Acroleine.**—A. Claus.

**Source of Error occasioned by the Use of Pettenkofer's Respiration Apparatus.**—W. Henneberg.

**Contribution to our Knowledge of the Synthesis of Cinnamic Acid.**—H. Schiff.—With this, as with many other papers, the great length and large space taken up by a series of very complex formulæ, render any useful abstraction of them impossible.

**On Benzilic Acid.**—A. Jena.—The author refers, first, to his former researches on this subject, and then states that he has prepared the baryta-salt of this acid,  $(C_{14}H_{11}O_3)_2Ba$ , a crystalline solid substance, readily soluble in water, decomposed, by distillation, into carbonic acid and benzhydrol—



Diphenyl-glycolic acid. Benzhydrol.

The author says that the formula to be assigned to benzilic acid is that which considers it to be diphenyl-glycolic acid.

As a curiosity, we may mention that, from the correspondence of this Society's agents, the gentleman holding that position at St. Petersburg mentions the labours of Lady Anna Wolkow—

**On Isomeric Toluol-Sulpho Acids.**—The authoress, having very successfully completed and augmented, by interesting discoveries, the labours on this subject of Drs. Engelhardt and Latschinow. The lady is a member of the Imperial Russian Chemical Society.

*Annalen der Physik und Chemie, von Poggendorff, No. 4, 1870.*

This number contains the following original papers and memoirs:—

**Rotation Phenomenon of Holtz's Machine.**—J. C. Poggendorff.

**Composition and Constitution of Tourmaline.**—Dr. C. Rammeisberg.—The last instalment of this lengthy chemico-mineralogical essay.

**Emission, Absorption, and Reflection of the Heat Radiated at Low Temperatures.**—G. Magnus.—The last instalment of this lengthy memoir is divided into the following sections:—On reflection of heat; description of experiments; reflection from the surface of other substances than silver, glass, rock-salt, and sylvine; reflection under various angles; results.

**Theory of Colours.**—Dr. J. J. Müller.—Concluding portion of the memoir on this subject, divided into the following chapters:—On the fluorescence of the retina, as dependent upon the length of waves and the intensity of the light; on the table of colours; physiology of the theory of colours.

*Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 8, 1870.*

This number contains the following original papers and memoirs:—

**Action of Chlorine upon Aldehyde: a New Chloral.**—G. Krämer and A. Pinner.—The authors relate, at great length, a series of experiments made by them with some peculiar by-products obtained in the industrial manufacture of aldehyde, as now carried on in Germany. These products appeared to be perfectly useless, even for burning in spirit-lamps; and, hence, the authors investigated the possibility of applying that substance to the preparation of chloral (hydrate of). In the course of these researches, they obtained what they call a new chloral—after purification, a colourless oily fluid—which absorbs water with great avidity; but, when a single drop of that fluid is added to some of the oily liquid, it does not mix therewith. On being, however, stirred together, heat is evolved, and the mixture solidifies, forming a solid crystalline mass. The body also combines with alcohol; its percentage composition is—Carbon, 27.56; hydrogen, 3.07; chlorine, 60.4; vapour density, 86.01. These figures, the authors say, suit croton-chloral as well as butyl-chloral—the former being  $C_4H_3Cl_3O$ , carbon, 27.66; hydrogen, 1.71; chlorine, 61.38—the latter,  $C_4H_5Cl_3O$ . The further researches on this subject have proved the new body to be the croton-chloral. A chloride of this substance was obtained, and an acid, which undoubtedly proved that a new chloral had been discovered.

**Quantitative Estimation of Glacial Acetic Acid.**—F. Rüdorff.—The author preliminarily refers to the usual methods of the estimation in question, by means of a titrated soda solution, stating it to be unsatisfactory; and next mentions that his method is based upon the estimation of the freezing-point of the acid in question. The author enters at length into the details of his experiments, the chief point of interest of which is that perfectly pure and anhydrous acetic acid solidifies at  $16.7^{\circ}$ ; that if either water, alcohol, some salts, or sulphuric acid are present, these substances tend to lower the point of solidification, so that 100 parts of the pure acid, mixed with 24 of water, solidifies at  $-7.4^{\circ}$ .

**Action of Bromine upon Dichlorhydrine.**—L. Carius.—After referring to some former experiments on this subject, the author describes dichlor-dibromacetone,  $C_3H_2Cl_2Br_2O$ , a heavy liquid, not



**Free Rotation of the Movable Conductor and of the Solenoid of Ampère's Apparatus.**—Dr. G. Krebs.—Illustrated with engravings.

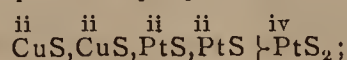
**Tension of Thin Fluid-Plates.**—R. Lüttge.

**Influence of the Temperature on the Sensitiveness and Delicacy of Spectrum Reactions.**—E. Cappel.—The main result which can be drawn from this lengthy paper is, that the temperature most suitable for the spectrum analysis of the alkalies is that of the oxyhydrogen flame; and, for the rest of the metals, the heat of the electric spark is most suitable. The higher the temperature, the more distinct the reactions.

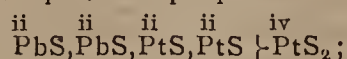
**Knochenhauer's Comparison of the Theory and Practice for the Oscillatory Electric Discharges in a Curved and Ramified Closed Conducting Wire.**—W. Feddersen.

**Floating of Solid Iron upon the Molten Metal, and Observations on the Trèves Experiment.**—Dr. L. Overzier.

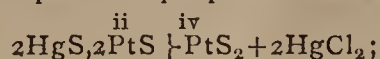
**New Sulphur Salts.**—R. Schneider.—(Fourth paper.) Among the large number of salts of this kind discovered by the author, we mention briefly—Cuproplatin-sulphoplatinate—



equivalent, 911.2; in percentages—Copper, 13.93; platinum, 64.99; sulphur, 21.08. Plumbo-platin-sulphoplatinate—



equivalent, 1199.2; in percentages—Lead, 34.58; platinum, 49.35; sulphur, 16.07. Mercurio-platin-sulphoplatinate *cum* mercurio-chloride—



in percentages—Platinum, 34.34; mercury, 46.32; chlorine, 8.22; sulphur, 11.12.

**Acoustic Attraction and Repulsion.**—K. H. Schelbach.

**Flexive Power Exerted by the Contraction of the Muscles.**—Dr. R. Most.—An algebraico-physiological paper.

**Memoir of the Life of the Late Professor Magnus.**—Dr. Poggendorff.

*Journal für Praktische Chemie* (double number), Nos. 6 and 7, 1870

This number contains the following original papers and memoirs:—

**Persulphocyanic Acid and Pseudo-Sulphocyanogen.**—Dr. L. Glutz.—Continuation and end of this memoir.

**Action of Anhydrous Sulphuric Acid on some of the Chlorine and Sulphur Compounds.**—Dr. H. E. Armstrong.—This lengthy memoir is divided into the following sections:—Action of sulphuric anhydride upon tetrachloride of carbon; action of sulphuric anhydride upon chlorobenzol, benzo-trichloride, and dichlorhydrine; action of sulphuric anhydride upon hexachlorbenzol; action of sulphuric anhydride upon sesquichloride of carbon; action of sulphuric anhydride upon sulphide of carbon; action of sulphuric anhydride upon protochloride of phosphorus; properties and reactions of pyrosulpho-chloride.

**Causes and Nature of Chemical Combinations.**—Dr. Mohr.

**Direct Preparation of Urea from Carbonic Acid and Ammonia.**—A. Basaroff.

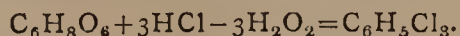
**Some of the Derivatives of Cyanamide.**—H. Kolbe.—This lengthy paper is divided into the following sections:—Dicyandiamide and dicyandiamidine; cyanurea; dicyanic acid; amidocyanic acid; glyciocamine and kreatinine.

**Hydrogenium-Amalgam.**—O. Loew.—Hydrogenium-amalgam is prepared by shaking together, in a vessel to be kept very cool, a mixture of mercury containing from 1 to 2 per cent of metallic zinc, along with an equal bulk of a solution of chloride of platinum containing 10 per cent of solid chloride. A slimy mass is obtained, devoid of metallic lustre and prone to decomposition, owing to the presence of some zinc and some compounds of that metal; but, on treating the mass with dilute hydrochloric acid, a body having the consistence of butter is obtained, which, according to the author, is a true amalgam of mercury and hydrogenium. The author describes at length several reactions of this body, which, in many of its properties, is akin to hydrogenium-palladium.

*Bulletin Mensuel de la Société Chimique de Paris*, May, 1870.

This number contains the following original papers and memoirs:—

**Trichlorhydrine and Substances Isomeric with it.**—M. Berthelot.—The author says—Trichlorhydrine, a body consisting of carbon, hydrogen, and chlorine, is prepared from glycerine and hydrochloric acid—



But this composition and formula also belong to a series of other bodies, among which those obtained by the following reactions:—The action of chlorine upon the chloride of propylen; action of chlorine upon the chlorinated propylen derived from acetone; action of chlorine upon allyl-iodhydric ether, isopropyl-iodhydric ether, and hydruret of propylen; action of perchloride of phosphorus upon acroleine, &c. The author describes at length the comparative investigations made by him on this subject, and summarises the results by stating that tri-

chlorhydrine has not been hitherto produced but from substances which take their origin from glycerine, while there exist at least five series of isomeric chlorinated substances—viz., the derivatives of the hydruret of propylen,  $\text{C}_6\text{H}_8$ ; the derivatives of the chlorhydrate of propylen,  $\text{C}_6\text{H}_6\text{HCl}$ ; the derivatives of the normal chloride of propylen,  $\text{C}_6\text{H}_6\text{Cl}_2$ ; the derivatives of the isochloride of propylen; the derivatives of trichlorhydrine corresponding to the glycerine.

**On Tribromhydrine.**—M. Berthelot.—This paper is a refutation of what has been published by M. Henry on this subject.

**Reaction between Oxychloride of Carbon and Benzene.**—M. Berthelot.—The result of the author's researches, undertaken with the view to test the accuracy of the results of some investigations made on this subject by Dr. Graebe, is to the effect that free oxychloride of carbon does not, at any temperature whatever, when acting upon benzene, form benzoic chloride.

**Substances Isomeric with Trichlorhydrine.**—M. Berthelot.—This lengthy essay contains the theoretical discussion on this subject. As might be expected, the paper abounds with formulæ.

**Glycol and Octylic Chlorhydrine.**—P. de Clermont.—This paper is divided into the following sections:—Action of nitric acid upon octylic glycol; chlorhydrine of octylic glycol.

**General Theory of Chemical Action: Action of Chloral upon Aniline.**—E. J. Maumené.—The author desires to prove (and this is demonstrated with a series of formulæ) that it may be possible to obtain indigo artificially, by the action of chloral upon aniline; but the practical experiments of the author, as related, do not at all lead to this result.

*Les Mondes*, May 26, 1870.

**Chemically-Prepared Bread.**—Dr. Sacc.—The author, writing to the editor, and sending, also, a sample of the bread prepared, says—We are acquainted with bread prepared with substances capable of evolving carbonic acid to render the bread spongy; but, since in bread so prepared the gluten and starch are not, as is the case in bread fermented with yeast, rendered partly soluble, such bread is heavy, and, instead of swelling up, if put into soup it crumbles away and disintegrates. I have tried to remedy this defect, well knowing that chemistry gives us the means and suitable materials to effect the same change as yeast does; and I make use of cheap, simple, and healthy substances, obtainable everywhere (but not further specified). The editor of *Les Mondes* states that the sample of the bread sent him, although it had become dry and stale, was excellent in every respect, but, perhaps, a little too salt for those accustomed to the bread of Paris.

**Preparation of Optically-Neutral Sugar.**—E. J. Maumené.—The author mixes equal parts of pure sugar candy and neutral nitrate of silver, both previously dissolved in water, and evaporates the mixture upon a water-bath. He states that, neither at 100°, nor even at 140°, any decomposition ensues, or any reduction of silver takes place, provided the sugar be free from inverted sugar. The author confirms, what was found twenty years ago by Dr. G. Mulder, that sugar candy (white) and best refined lump sugar, do not contain any trace of glucose. The sugar rendered syrupy by the process described is optically neutral. The silver-salt is separated from the sugar by means of pure chloride of calcium, and the nitrate of lime is separated from the sugar by the addition of alcohol, and placing this mixture under a bell-jar along with quick-lime. In this manner, by slow concentration, two layers, of different specific gravity, are formed; the upper being an alcoholic solution of nitrate of lime, the lower a viscous saccharine liquid. The former is poured off, and, by a slight washing with cold distilled water, the thick sugar solution is freed from any adhering nitrate of lime. The sugar obtained does not crystallise, does not act upon the cupro-potassic liquor, and readily combines with lime, which base is completely withdrawn by the action of carbonic acid.

June 2, 1870.

**Success of a Missionary who Loves Science.**—Rev. F. Moigno.—Under this title, the author relates some curiosities of the success obtained by the Rev. A. David, who, as a missionary of the Lazarist Society, has explored Central Asia (Thibet, Mongolia, China), and has brought to Europe a large number of specimens of plants and animals hitherto unknown to Western civilisation. We particularly call attention to this paper, because it contains some very curious statements about a deer-park existing near Pekin, surrounded by a high wall, no less than about 32 miles in circumference, and containing various species of large mammalia not hitherto seen elsewhere. It is rather strange that, since Pekin is the abode of several European Embassies (a French one to boot), the existence of this place *à quelques pas* ausud of Pekin should not have been long since known.

**New Manure (Courrière Guano).**—MM. A. Tilloy-Delaune and Co.—It appears that Indian corn (*zea mais*) has been, and is now largely used in French distilleries. This grain, previously coarsely broken, is boiled with dilute sulphuric acid, in order to convert its starch into sugar. After fermentation, however, the residue of the distillation is not suitable for feeding cattle. The firm alluded to, large distillers at Courrières (Pas de Calais), run the refuse from the stills into large tanks, and, after all solid matters have subsided, run off the clear liquid, and obtain a residue containing the following percentages:—Water, 8.77; organic matters (inclusive 4.68 nitrogen), 68.35; mineral matters, 18.58; yielding an excellent manure.

**Meteorites Observed from November 14th, 1869, to March 11th, 1870.**—Rev. Father P. Denza, S.J.—Astronomically-observed meteorites at Moncalieri (Italy).



**Improved Centrifugal Pump.**—M. Coudurier.—This memoir, illustrated with several excellent woodcuts, states that the pumps alluded to are superior in effect, and surpass in simplicity of construction and force of action any hitherto made. Particulars may be obtained by addressing M. Coignard, 68, Boulevard du Prince Eugène, Paris.

**Fermentation and Small Organisms.**—E. Du Mesnil.—This rather lengthy paper contains some very curious opinions on fermentation, which is, according to the author's ideas, the joint-work of electricity, magnetism, and ammonia, acting together in a very complex and not well defined manner.

*Revue Hebdomadaire de Chimie*, May 26, 1870.

**Ice-Making Machine and Cooling Apparatus for Brewer's Wort.**—L. Martin and M. Vindhhausen.—Lengthy and full description of two apparatus based upon the principle that, if the expansion of a gas (atmospheric air, in this instance) is effected by mechanical means, absorption of heat—in other words, production of cold—takes place. The ice-making machine produces 100 kilos. of ice at a cost of about sixpence. The cooling apparatus is so arranged as to effect a drying of the malt and cool the wort at the same time.

**Ammonia Machine.**—M. Frot.—The first portion of a paper describing a contrivance wherein ammonia is employed instead of steam for the same purposes for which the latter is now applied.

**Chemists' and Mineralogists' Travelling Companion.**—MM. Alvergnaat.—This paper, accompanied by a woodcut, gives the detailed description of a very neatly-arranged box, 50 by 30 and 20 centimetres, weighing, when full, only 3 kilos., and containing all the necessary requisites for chemical or mineralogical research on a journey and at a distance from laboratories. The makers are celebrated for their goods; the price (not specified) is said to be very moderate.

**Tanning by the Aid of Carbonic Acid.**—M. Polefroy.—This process consists in submitting the hides (previously limed) to the action of a strong current of carbonic acid, in order to dissolve the tannate of lime first formed, and to aid the penetration of the tannic acid in the skins and hides.

**So-called Cold Galvanisation of Iron and Cast-Iron.**—V. Roque.—The iron is first cleaned by being placed in a bath made up of—Water, 1000 litres; chlorhydric acid, 550 litres; sulphuric acid, 50 litres; glycerine, 20 litres. On being removed from this bath, the metal is placed in a bath containing 10 per cent of carbonate of potassa, and is next transferred to a metallising bath consisting of—Water, 1000 litres; chloride of tin, 5 kilos.; chloride of zinc, 4 kilos.; bitartrate of potassa, 8 kilos.; acid sulphate of alumina, 4 kilos.; chloride of aluminium, 10 kilos. The metal has to be left in this mixture for from three to twelve hours, according to the thickness of the layer of zinc to be desired.

*Monatsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin*, March, 1870.

This number contains the following original papers and memoirs relating to chemistry:—

**Substituted Melamines.**—Dr. A. W. Hofmann.

**Bodies Isomeric with Cyanuric Acid Ether.**—Drs. A. W. Hofmann and O. Olshausen.—Both these memoirs are too lengthy for any useful abstraction.

**Distribution of the Temperature of Central Europe during the past Winter.**—Dr. Dove.—From the various meteorological phenomena observed, the author draws the conclusion that any abnormally-low temperature in Europe travels from the east to the west, while any subsequent abnormally-high temperature moves from the west to the east. The observations quoted in this paper extend over almost the whole of Europe and a large portion of the United States of America.

*Revue des Cours Scientifiques de la France et de l'Etranger*, May 28, 1870.

Although this number does not contain any paper relating directly to chemistry, we must not omit to quote—

**Condition of Sciences during the Middle Ages.**—Dr. H. Kopp.—This lecture of the well-known author of the excellent "Geschichte der Chemie," is a very valuable contribution to our knowledge of the history of sciences, as well as to the organisation of the more ancient universities of Europe. We regret that the length of the discourse prevents us entering into details, many of which are interesting as well as amusing.

June 4, 1870.

This number contains the first of a series of lectures on the—

**Isomerism of the Elementary Bodies; Different States of Existence of Oxygen.**—Dr. Berthelot.—We regret that the length of this paper (a verbatim report) forbids our entering into any detailed abstraction as regards ozone. The author says that there exists, at least in some cases, a certain relation between the states (allotropism of Berzelius) of an element in free state, and the nature of the combination from which it is disengaged; that an elementary body in a certain state can more readily enter into one kind of combination than in another; that an elementary body can change (can

become allotropic) simultaneously whilst it is in combination with another body.

*Moniteur Scientifique*, No. 323, June 1, 1870.

This number contains the following original papers relating to chemistry and collateral sciences:—

**Influence of the Motion** (that is to say, swift movement in a certain direction) of a Source of Sound or Light upon the Sound or Light Emitted from the Object in Motion.—R. Radan.—This paper refers to the researches of Dr. Doppler, made in 1842; those of Dr. Buys-Ballot, made in 1845, upon the Dutch-Rhenish railway; and to the experiments made by M. Fizeau, and many other savants, on this subject.

**Critical Essay on M. J. Raulin's Labours on Vegetation.**—F. Papillon.—A very lengthy memoir.

## NOTES AND QUERIES.

**Bauxite.**—If "J. B. S." will write to Dr. Lunge, South Shields, he will learn where this mineral can be obtained on a large scale.

**Phosphate of Ammonia.**—Will the gentleman who answered an enquiry regarding the manufacture of phosphate of ammonia oblige by giving details of the process, or state where full information may be obtained?—J. W. M.

**The Metric System.**—Observing Mr. Woodward's note in the CHEMICAL NEWS (vol. xxi., p. 273), I beg to suggest the following abbreviations, in place of those used by M. Evers, for the terms employed in the metric system of weights and measures:—Myriametre, mym.; kilometre, kim.; hectometre, hem.; decametre, dem.; metre, m.; decimetre, dm.; centimetre, cm.; millimetre, mm.; square kilometre, sq. kim., or kim.<sup>2</sup>; square metre, sq. m., or m.<sup>2</sup>; square centimetre, sq. cm., or cm.<sup>2</sup>; stère or cubic metre, s. or c.m., or m.<sup>3</sup>; cubic centimetre, c.cm., or cm.<sup>3</sup>; cubic millimetre, c.mm., or mm.<sup>3</sup>; kilolitre, kil.; hectolitre, hel.; kilogramme, kigm.; gramme, gm.; decigramme, dgm.; centigramme, cgm.; milligramme, mgm. The Greek prefixes, which denote multiples, are thus represented by their first two letters; and the Latin prefixes, which denote sub-divisions, indicated by their first letter: gramme is gm., as gr. would still be required for grain.—J. CURRIE.

## MEETINGS FOR THE WEEK.

MONDAY, June 20th.—London Institution, 8.

TUESDAY, 21st.—Ethnological, 8.

WEDNESDAY, 22nd.—Geological, 8.

THURSDAY, 23rd.—Royal Society Club, 6.30. Anniversary.  
Zoological, 8.30.

FRIDAY, 24th.—Quekett Microscopical Club, 8.

## TO CORRESPONDENTS.

Frank H. Storer is thanked for his valued communication. We hope for more anon, as promised.

J. Pattinson.—Thanks for your communication; it shall receive attention.

**Hyposulphite of Soda** alone is of no use in dyeing hair; it requires the addition of a lead solution. You had better write to the journal in which you saw the statement.

W. H. Walenn.—Received, with thanks.

J. F. Hill.—Apply to Roberts, Dale, and Co., Cornbrook Chemical Works, Manchester.

**Chartism.**—The reactions are very simple, and are to be found in every book on analysis.

J. Currie.—Mr. J. C. Morton's "Cyclopædia of Agriculture" will probably meet your requirements; it is published in 2 vols. by Blackie and Son. Baxter's "Library of Agriculture," 2 vols. (Simpkin and Co.); "The Rural Cyclopædia," by the Rev. J. Wilson, 3 vols. (Fullarton and Co.); and Doyle's "Cyclopædia of Practical Husbandry," published by H. G. Bohn, are also good books on the subject.

## BOOKS RECEIVED.

Researches on Diamagnetism and Magne-Crystalline Action, including the Question of Diamagnetic Polarity. By John Tyndall, LL.D., F.R.S. London: Longmans and Co.

Notes of a Course of Nine Lectures on Light, delivered at the Royal Institution of Great Britain, April—June, 1869. By John Tyndall, LL.D., F.R.S. London: Longmans and Co.

Water Analysis; a Practical Treatise on the Examination of Potable Water. By J. Alfred Wanklyn, M.R.C.S., late Professor of Chemistry to the London Institution; and Ernest Theophrastus Chapman. 2nd Edition, Edited by E. T. Chapman. London: Trübner. 1870.



# THE CHEMICAL NEWS.

VOL. XXI. No. 552.

## ON THE AMMONIA COMPOUNDS OF PLATINUM.\*

By WILLIAM ODLING, M.B., F.R.S.,  
Fullerian Professor of Chemistry, Royal Institution.

FOR nearly a century past ammonia gas, discovered by Priestley in 1774, has been a subject of extreme interest to chemists. This ammonia gas,  $\text{H}_3\text{N}$ , is especially characterised by its property of uniting directly with hydrochloric acid gas,  $\text{HCl}$ , to form a solid deposit of sal-ammoniac, or hydrochloride of ammonia,  $\text{H}_3\text{N}.\text{HCl}$ .

In several important particulars, sal-ammoniac presents a remarkable similarity of behaviour to chloride of potassium: and by linking together the hydrogen of its acid with its ammonia so as to form the grouping  $\text{H}_3\text{N}.\text{H}$  or  $\text{H}_4\text{N}$ , it may be regarded as the chloride of a composite metal ammonium, just as potassium chloride is the chloride of the simple metal potassium; thus:—



Ordinarily, when potassium chloride is subjected to the action of a weak current, no potassium, but only potash, makes its appearance at the negative pole; but if the negative pole be constituted of a drop of mercury, the electrolytically-liberated potassium remains dissolved in the mercury as potassium-amalgam,  $\text{K}_x\text{Hg}_y$ . Similarly, when solution of sal-ammoniac is subjected to electrolysis, the negative pole being constituted of mercury, there is produced a bulky amalgam of ammonium  $(\text{H}_3\text{N}.\text{H})_x\text{Hg}_y$ ; which, however, when no longer under the influence of the current, speedily breaks up into ammonia, hydrogen, and mercury. Ammonium-amalgam may further be produced on a large scale by the action of potassium-amalgam or sodium-amalgam on sal-ammoniac solution, thus:—



Another characteristic property of ammonia gas is its extreme solubility in water. By its dissolution it furnishes a liquid having many of the properties of aqueous potash, as, for example, the properties of affecting test-paper, of neutralising acids, and of precipitating metallic salts. And just as sal-ammoniac may be regarded as a chloride of ammonium, analogous to chloride of potassium, so may aqueous ammonia be regarded as a hydrate of ammonium analogous to hydrate of potassium, thus:—



But whereas chloride of ammonium, analogous to chloride of potassium, constitutes a definite body,—hydrate of ammonium, analogous to hydrate of potassium, has an inferential existence only. It is inferred to exist in solution from the reactions of the solution; but, under all attempts at extraction, it breaks up into ammonia gas and water, thus:—

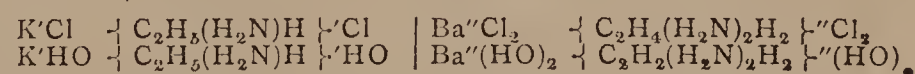


But by far the most interesting circumstance with regard to ammonia is its property, so remarkably developed by Hofmann, of serving as a type from which compounds of the most varied character are derivable by substitution. Just, for example, as the hydrocarbon residue, or radical, ethyl,  $\text{C}_2\text{H}_5$ , can replace the hydrogen of hydrochloric acid to form ethylic chloride,  $\text{C}_2\text{H}_5.\text{Cl}$ , so can it also replace the hydrogen of ammonia to form ethylamine,

$\text{C}_2\text{H}_5.\text{H}_2\text{N}$ . This ethylamine constitutes a very volatile liquid, vapourising considerably even at ordinary temperatures. Its vapour closely resembles ammonia gas, but is distinguishable therefrom by its ready inflammability. Like ammonia, ethylamine combines directly with hydrochloric acid to form ethylamine sal-ammoniac, or hydrochloride of ethylamine,  $\text{C}_2\text{H}_5.\text{H}_2\text{N}.\text{HCl}$ . Like ammonia, also, ethylamine is extremely soluble in water; and its solution, like that of ammonia, behaves in many respects as a definite hydrate,  $\text{C}_2\text{H}_5.\text{H}_2\text{N}.\text{H}_2\text{O}$ , not obtainable, however, in the isolated state, but, like hydrate of ammonia, known only in the state of solution.

There exist, moreover, derivatives of ammonia in which a portion of its hydrogen is replaced, not by a monad, but by a diad residue or radical. Just, for example, as diad ethylene,  $\text{C}_2\text{H}_4$ , replaces the hydrogen of two units of hydrochloric acid to form ethylenic chloride,  $\text{C}_2\text{H}_4.\text{Cl}_2$ , so can it also replace, in part, the hydrogen of two units of ammonia to form ethylenamine,  $\text{C}_2\text{H}_4(\text{H}_2\text{N})_2$  or  $(\text{C}_2\text{H}_4)''\text{H}_4\text{N}_2$ . This double ammonia unites with *two* units of hydrochloric acid to form the definite hydrochloride,  $\text{C}_2\text{H}_4(\text{H}_2\text{N})_2.2\text{HCl}$ , and with *two* units of water to form the equally definite, stable, isolable, volatile, crystallisable hydrate,  $\text{C}_2\text{H}_4(\text{H}_2\text{N})_2.2\text{H}_2\text{O}$ .

The hydrochloride and non-isolable hydrate of ethylamine being compared with the chloride and hydrate of the monad alkali-metal potassium, the hydrochloride and isolable hydrate of ethylenamine are similarly comparable with the chloride and hydrate of the diad alkali-metal, barium, thus:—



And hydrate of ethylenamine agrees with hydrate of barium, as well in being a powerfully alkaline base, as in being de-hydratable, not by the action of heat, but by indirect methods only.

Through the further researches of Hofmann, chemists are acquainted with ammonias and di-ammonias, in which, not only one-third, but two-thirds and three-thirds of the hydrogen are replaced by monad ethyl and diad ethylene respectively. With regard to these compounds, both in their properties and in the nature of the hydrochlorides and hydrates which they furnish, di- and tri-ethylamine correspond very closely to ethylamine; di- and tri-ethylenamine very closely to ethylamine.

	Ethylamines.	Ethylenamines.
Mono- ..	$(\text{C}_2\text{H}_5)'\text{H}_2\text{N}$	$(\text{C}_2\text{H}_4)''\text{H}_4\text{N}_2$
Di- ..	$(\text{C}_2\text{H}_5)'\text{H}_2\text{N}$	$(\text{C}_2\text{H}_4)''\text{H}_2\text{N}_2$
Tri- ..	$(\text{C}_2\text{H}_5)'\text{H}_3\text{N}$	$(\text{C}_2\text{H}_4)''\text{H}_3\text{N}_2$

Although, in this way, the principal developments and ultimate establishment of the idea of ammonia as a type have resulted from investigations in organic chemistry, the idea itself appears to have originated, in the first instance, from investigations made in mineral chemistry; and especially from the investigation of compounds formed by the reaction of certain metallic salts and ammonia. Graham, indeed, had early represented certain compounds of metallic chlorides with ammonia as being metallicised sal-ammoniacs; but the notion of ammonia as a trihydric type, susceptible of three successive degrees of substitution, was first enunciated by Laurent, and was employed by that most original chemist to explain, among other matters, the constitution of different ammoniated compounds of platinum, discovered by Magnus, Gros, and Reiset successively. These compounds he represented as being salts of derived ammonias, in which different proportions of the hydrogen of ammonia were replaced by platinum.

Platinum is a moderately hard pewter-coloured metal, possessed of many singular properties. It was first recognised as a distinct metal by Wood, an assayer of Jamaica, in 1741. The mode of working it was discovered and practised by Wollaston early in the present century, and described by him in the *Philosophical Transactions* for 1829. Platinum is especially characterised by its high

\* A lecture delivered before the Royal Institution of Great Britain, June 10, 1870.



specific gravity; by its low conductivity, dilatibility, and specific heat; by its high ductility and tenacity; by its facile divisibility and reducibility; by its curious absorptivity of certain gases, more especially hydrogen; by its difficult attackability by chemical agents; and by its infusibility at the highest furnace heats. And by each of these several properties, except, perhaps, its high specific gravity, is it suited to some special application in the arts.

Chemically, platinum is characterised by its high atomic weight, 197; and by its formation of two well-defined chlorides,—a perchloride, also known as platinic chloride, expressed by the formula  $Pt^{IV}Cl_4$ , and a protochloride, also known as platinous chloride, expressed by the formula  $Pt^{II}Cl_2$ . Platinic chloride occurs in crystalline dark orange masses, freely soluble in water. Platinous chloride forms an olive-brown amorphous powder, quite insoluble in water, but dissolving in hydrochloric acid to form an ochre-coloured liquid. In 1828, the late Professor Magnus, by supersaturating this liquid with ammonia, obtained a remarkable compound, containing the elements of platinous chloride and ammonia, and presenting itself as a dull green, usually crystalline, precipitate. This notable green precipitate has formed the subject of frequent investigation from then till now; and different views of its constitution, from time to time, have been put forward. But no one of these views has received a sufficiently general acceptance to warrant the designation of the compound in accordance therewith; so that, from the period of its discovery down to the present day, it has ever borne the honoured name of its discoverer, and been known as the green salt of Magnus.

Some time after, Gros, in 1838, by treating the salt of Magnus with nitric acid, obtained a peculiar series of pale yellow, or colourless, platin-ammonia compounds. Next in 1840-44 *et seq.*, Reiset and Peyrone, by acting on the salt of Magnus, or on platinous chloride itself, with ammonia, obtained, independently of each other, two additional series of compounds, having relations of metamorphosis both with one another and with the foregoing series of Gros. Then, in 1846, Raewsky, by acting on the salt of Magnus with nitric acid, obtained yet another series of compounds, differing from those furnished to Gros by the same reagent.

But the formulæ attributed by Raewsky to the salts which he had just discovered were inconsistent, both with Laurent's view of ammonia as a type, and with other views of chemical constitution which those illustrious fellow-workers, Laurent and Gerhardt, shared in common. Accordingly, Gerhardt, in 1848, subjected Raewsky's formulæ—notwithstanding their corroboration by a Committee of the Academy—to a most trenchant criticism; and, after supplementing his criticism by laboratory research, published, in 1850, his celebrated memoir "On the Ammoniacal Compounds of Platinum." In this memoir, he established the existence of another, entirely new, series of platin-ammonia compounds; he showed, by experiment, the simple relationship in which the salts of Raewsky stand to the salts of Gros; and he set forth a complete, self-consistent, scheme of viewing the several series of platin-ammonia compounds in their relations to ammonia and to one another.

Since the publication of Gerhardt's memoir, further important contributions to the knowledge of platin-ammonia compounds have been made by different chemists, especially by Buckton, Hadow, and Thomsen. But neither before nor since has any complete general scheme of the constitution of this class of bodies been put forward. Nevertheless, the scheme of Gerhardt, though always treated with respect, has never met with general acceptance, and nowadays, at any rate, is open to very serious objections.\*

\* Gerhardt's own base platinamine, for instance, is represented by the certainly improbable formula,  $pt_2HN$  or  $Pt^{II}HN$ , and its hydrochloride by the yet more improbable formula,  $pt_2HN.2HCl$ ; in which the unit of a mon-ammonia is represented as combined with two units of hydrochloric acid, and by which the entire chlorine of the salt is represented as fulfilling one and the same function,

The attention of the writer having, of late, been directed to the study of these compounds, he has succeeded in differentiating the simplest of the platinum sal-ammoniacs from several allied and isomeric bodies with which it had before been confounded; and in obtaining from it the corresponding hydrated base of the series. He has also obtained some reactions of interest with bodies belonging to the more complex series; and, as a general result of his inquiries, has ventured to put forward a new scheme of regarding the entire group of bodies. This scheme is based on the recognition of two principal facts or propositions:—

1. The different platin-ammonia compounds are produced, in the first instance, from platinous chloride,  $Pt^{II}Cl_2$ ; and just as the platinum of this compound possesses the property of taking up two additional proportions of chlorine, so as to furnish the platinic compound,  $Cl_2PtCl_2$ , or  $Pt^{IV}Cl_4$ , so also does the platinum of the different ammoniated bodies obtained from platinous chloride possess the property of taking up two proportions of chlorine, or its equivalent of other negative radical, so as to furnish platinic compounds corresponding to the original platinous compounds respectively. Hence, the division of platin-ammonia compounds into the two classes of platinous and platinic; the compounds of the former, differing in constitution from those of the latter class, just as platinic differs from platinous chloride, by a direct fixation of chlorine.

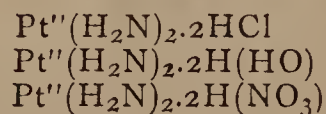
2. The monad residue, or radical amidogen,  $H_2N$ , is capable of becoming the monad radical ammon-amidogen,  $H_2N.H_3N$ , or  $H_5N_2$ , just as the monad radical methyl,  $H_3C$ , is capable of becoming the monad radical methylen-methyl or ethyl,  $H_3C.H_2C$  or  $H_5C_2$ .\* Viewing sal-ammoniac,  $H_3N.HCl$ , as the analogue of methylic chloride,  $H_2CHCl$ , the difference is noticeable that, while the ammonia both of sal-ammoniac and ammon-amidogen is easily separable, the methylen both of methylic chloride and methylen-methyl is inseparable from the remaining constituents of the respective compounds. Hence, the distinction between the two classes of amic and ammon-amic platinum compounds, the latter differing from the former by an actual addition of diad ammonia, much as ethylic differ from methylic compounds by a virtual addition of diad methylen. The parallelism is indicated in the under-written formulæ for methylic chloride and ethylic chloride, sal-ammoniac and ammonio-chloride of silver, respectively—



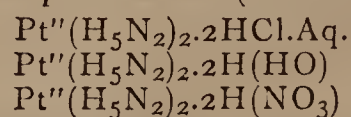
The group of platin-ammonia compounds is thus divisible into the two classes of platinous and platinic; and each of these again into the two classes of amic and ammon-amic compounds. To these four classes must yet be added a fifth sub-class of di-platinic compounds, including the nitrate-chloride of Raewsky, and the subsequently-discovered nitrate of Gerhardt and chloride of Hadow. The scheme of the constitution of the entire group, in accordance with the writer's views, is exhibited in the accompanying table of the principal chloride, hydrate, nitrate, and nitrite compounds.

#### PLATINUM BASES AND SALTS (PROPOSED SCHEME).

##### Platosamine.



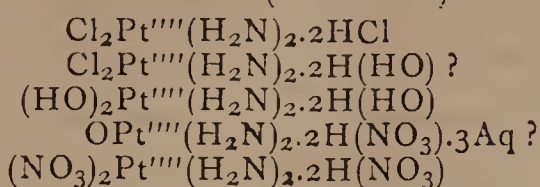
##### Amo-platosamine (Reiset's).



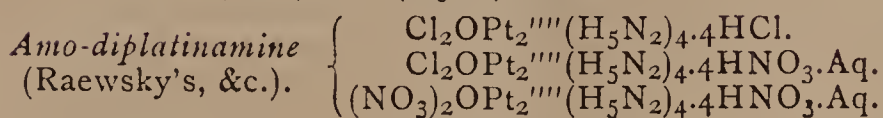
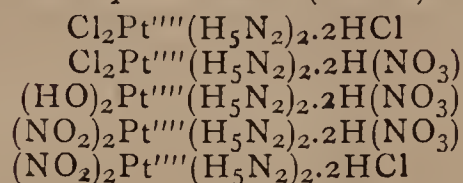
\* *Philosophical Magazine*, 1869, p. 459.



*Platinamine* (Gerhardt's).

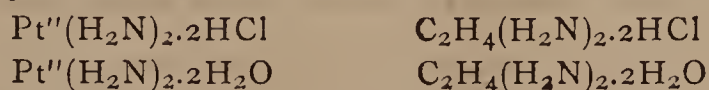


*Amo-platinamine* (Gros's).



*Platosamine*.

The hydrochloride is obtainable by direct action of platinous chloride,  $\text{Pt}''\text{Cl}_2$ , on ammonia, just as ethylenamine hydrochloride is obtainable by direct action of ethylenic chloride,  $(\text{C}_2\text{H}_4)''\text{Cl}_2$ , on ammonia; and, in both reactions, the two compounds are each accompanied by various other products. The parallelism, in constitution and properties, of the two compounds and of their corresponding hydrates is complete—



Hydrochloride of platosamine, in its pure state, has a dull, very pale, primrose colour, approaching almost to white. It is very insoluble in cold, considerably more soluble in hot water.\* From its concentrated hot solution it is usually deposited as a flocculent-looking, though really crystalline, or partly crystalline, precipitate; and by slow cooling of the solution, it may be obtained wholly in the form of distinct needles. The base is obtained from the hydrochloride, through the intervention of the sulphate, by decomposing the latter with baryta water. It is extremely soluble in water, and readily crystallisable. It furnishes a solution manifesting a strongly alkaline reaction, liberating ammonia from its salts, neutralising acids, absorbing carbonic acid from the air, and decomposing metallic salts—the precipitates thrown down being, however, for the most part double compounds.

The base and other soluble platosamine compounds are characterised by giving with hydrochloric acid a precipitate of the hydrochloride, which, when formed in this way, is almost always yellow and crystalline. All platosamine compounds, including the hydrochloride, exhibit the platinous property of absorbing chlorine, and hence of decolourising a mixture of hydrochloric acid and permanganate, to yield platinamine compounds; and they all, including the hydrochloride, dissolve in gently-heated ammonia, to yield their corresponding amo-platosamine compounds.

*Amo-platosamine*.

The hydrochloride of this series, unlike that of the preceding, is freely soluble in water. It is a beautiful salt, crystallising usually in a mass of interlaced lengthy needles. It is made by dissolving platinous chloride, salt of Magnus, or the above platosamine hydrochloride, in aqueous ammonia at a gentle heat. The hydrated base is obtained from it, as is the preceding hydrated base from the preceding hydrochloride. The so-produced hydrate corresponds in its general properties with the above hydrate of platosamine, than which, however, it is far more powerfully alkaline. From different metallic salts it throws down the respective metallic hydrates.

Amo-platosamine salts, like those of platosamine, exhibit the platinous property of decolourising a mixture

of hydrochloric acid and permanganate, of directly absorbing chlorine or bromine, and also of directly absorbing nitric peroxide, to furnish amo-platinic compounds.\* The resulting amo-platinic chloro-chloride occurs as a pale yellow, the nitro-chloride as a pale green, and the nitro-nitrate as a pale blue precipitate. Amo-platosamine is further distinguished from platosamine by the free solubility of its hydrochloride, and by the reaction of this salt with platinous chloride solution to throw down the green salt of Magnus.

*Platinic Compounds*.

The most characteristic of the salts of platinamine is the chloride  $\text{Cl}_2\text{Pt}''''(\text{H}_2\text{N})_2 \cdot 2\text{HCl}$ . It is best made by addition of permanganate, in very slight excess, to a hot solution of platosamine hydrochloride, acidified with hydrochloric acid. It is a beautiful bright yellow salt, dissolving sparingly in cold, moderately, though, on account of its density, somewhat slowly, in boiling water; and crystallising readily on cooling in isolated octohedrons or square plates. It reacts with excess of ammonia, at a gentle heat, to form the insoluble chloride of amo-platinamine. Its chlorine, like that of the amo-platinic chloride, is evidently in two different conditions of attackability by reagents, such as alkalies and silver salts. The hydrate of platinamine is obtained from the hydrate-nitrate, by means of ammonia, as a neutral, almost insoluble, bright yellow, crystalline precipitate.

The best known salt of amo-platinamine is the chloro-nitrate,  $\text{Cl}_2\text{Pt}''''(\text{N}_2\text{H}_5)_2 \cdot 2\text{HNO}_3$ , obtained by treating the salt of Magnus, or preferably the hydrochloride of amo-platosamine, with nitric acid. It is moderately soluble in water, and crystallises therefrom in brilliant white flat prisms. Its chlorine is not immediately recognisable by nitrate of silver; and is only partially precipitable thereby, even after long boiling. Its solution yields, with ammonium chloride and sodium sulphate, crystalline white precipitates of the chloro-chloride and chloro-sulphate respectively.

The most familiar salt of amo-diplatinamine is the chloroxy-nitrate,  $\text{Cl}_2\text{OPt}_2''''(\text{H}_5\text{N}_2)_4 \cdot 4\text{HNO}_3 \cdot \text{Aq}$ . It is best made by boiling the chloro-nitrate or chloro-chloride of amo-platinamine with nitric acid and nitrate of silver. It presents considerable resemblance to the chloro-nitrate of amo-platinamine, but its solution is not disturbed either by sulphate of sodium or chloride of ammonium. It yields, moreover, with platinous chloride solution, a moss-like coppery precipitate which is highly characteristic (Hadow).

NOTE ON THE  
TEMPERATURE AND HEATING-POWERS OF  
FLAMES.†

By W. M. WATTS, D.Sc.

MR. WATTS has forwarded to us the following remarks on Messrs. Silliman and Wurtz's paper "On the Temperatures of Flames," which appeared in our last and previous numbers, in which certain conclusions on some practical points of importance are stated.

The following numbers are correctly given as representing the amounts of heat evolved by the complete combustion of equal volumes of the following gases:—

Hydrogen .. .. .	34462
Carbonic oxide .. .. .	33642
Marsh gas .. .. .	104504
Olefiant gas .. .. .	166012

\* The orange-yellow, scaly, far more soluble hydrochloride, obtained by dissolving salt of Magnus in sulphate of ammonia solution, is a distinct compound.

† The reaction of amo-platosamine compounds with nitric peroxide was discovered by Hadow, but received from him a different interpretation.

† From the *Philosophical Magazine*, May, 1870.



But the conclusion that the heating-power of olefiant gas is greater than that of an equal volume of hydrogen is condemned as erroneous; and the authors give, as the result of their investigations, "that the powers of the flames of pure hydrogen and pure olefiant gas, even when used to the greatest advantage, to heat water below its boiling-point are almost or quite identical."

There seems to be, throughout the paper, a confusion between the *heating-power* of a gas and the *temperature of its flame* in air.

It is quite true that, because the specific heat of steam (which is one of the products of combustion of olefiant gas) is greater than the specific heat of carbonic anhydride (the only product of combustion of carbonic oxide), the calculated flame-temperature of the latter gas is higher than that of the former; but, for the very same reason, if these gaseous products of combustion expend their heat in raising the temperature of water, the greatest effect will be produced by the olefiant gas, although the temperature of its flame is not so high as that of the flame of carbonic oxide. If the gases give up the whole of their heat to the water, it is obvious that the calorific effects must be precisely in the ratio of the numbers already quoted; and, even if they escape at a temperature considerably above  $0^{\circ}\text{C}$ ., their relative effects will be nearly the same. If we suppose the products of combustion to have a temperature of  $200^{\circ}\text{C}$ . when they escape, the following quantities of heat will still be available by the combustion of equal volumes of carbonic oxide and olefiant gas:—

Gas burnt..	Lbs. of water raised from $0^{\circ}\text{C}$ . to $100^{\circ}\text{C}$ .
14 lbs. carbonic oxide .. ..	314
14 lbs. olefiant gas .. ..	1546

And these numbers are almost exactly in the same ratio as the numbers 33642 and 166012. We conclude, therefore, that the numbers quoted (vol. xxi., p. 282), in which, according to Messrs. Silliman and Wurtz, "several most grave errors are involved," do, in reality, strictly represent the heating-effects of the different gases when employed the greatest advantage, in heating water below  $100^{\circ}\text{C}$ .

The omission of the correction for the latent heat of steam in Bunsen's original calculation of the temperature of the hydrogen-flame has been already pointed out by Dibbits.\*

In the calculation of the temperature of the hydrogen-flame given in this paper (p. 283), there is also an error in assigning to liquid water the specific heat 0.4805, instead of 1. The formula should be—

$$x = \frac{34462 - 9(637 - 48.05)}{4.3245} = 6743^{\circ}\text{C}.$$

Another of the conclusions arrived at in this paper is erroneous, viz., "That, of all known gases, the highest calorific effects,† under ordinary atmospheric conditions, are obtainable from *carbonic oxide*, whose calorific value, above  $100^{\circ}\text{C}$ ., is about  $3000^{\circ}\text{C}$ ."

The flame of cyanogen is hotter than that of carbonic oxide, the calculated temperature of the flame of cyanogen in air being  $3519^{\circ}\text{C}$ ., and in oxygen no less than  $10557^{\circ}\text{C}$ . It must be remembered, however, that these results of calculation in no way express the actual flame-temperatures. The calculated temperature of the oxy-hydrogen-flame is  $6743^{\circ}\text{C}$ .; but the experiments of Deville‡ and Bunsen|| agree in fixing between  $2500^{\circ}\text{C}$ . and  $2800^{\circ}\text{C}$ . The following are the calculated and experimental flame-temperatures of certain gases; it will be seen that the flame of cyanogen is shown by experiment also to have the highest temperature:—

	Calculated. $^{\circ}\text{C}$ .	Experimental. $^{\circ}\text{C}$ .
Hydrogen in air .. ..	2701	2024
" " oxygen .. ..	6743	2844
Carbonic oxide in air .. ..	2996	1997
" " oxygen .. ..	7067	3033
Cyanogen in air .. ..	3519	3297
" " oxygen .. ..	10557	—
Olefiant gas in air .. ..	2727	—
" " oxygen .. ..	8606	—

## ON THE DESCENT OF GLACIERS.\*

By The Rev. HENRY MOSELEY, M.A., F.R.S.,  
Canon of Bristol, and Instit. Imp. Sci. Paris Corresp.

(Concluded from p. 278.)

All Alpine travellers, from De Saussure to Forbes and Tyndall, have borne testimony to the intensity of the solar radiation on the surfaces of glaciers. "I scarcely ever," says Forbes, "remember to have found the sun more piercing than at the Jardin." This heat passes abruptly into a state of intense cold when any part of the glacier falls into shadow by an alteration of the position of the sun, or even by the passing over it of a cloud. Now the Mer de Glace moves faster by day than by night. Its mean daily motion is twice as great during the six summer as during the six winter months. The connection between its rate of motion and the external temperature is most remarkable. It has been carefully observed, and the results as recorded by Professor Forbes leave no doubt of the fact, that no change of external mean temperature is unaccompanied by a corresponding change of glacier motion. From this it follows that the two are either dependent on some common cause, or that the one set of changes stands in the relation of a cause to the other. That both sets of phenomena—the changes of the sun's heat, and the changes of glacier motion—should be due to some common independent cause, seems impossible. We are forced, therefore, on the conclusion that one is caused by the other. And as the changes in the glacier motion cannot cause the changes of solar heat, it must be the changes of solar heat which cause the changes of glacier motion. The sun is obviously *master* of the glacier. Nor is this to be considered a startling or improbable conclusion. Heat is but another form of mechanical power. This power is constantly streaming into the glacier; for ice is *dia-thermanous*. It is readily penetrable by luminous heat. This has been shown by Tyndall, who, having sent a beam of heat through a block of Wenham Lake ice, saw its course starred by the dilations of the ice. I have, moreover, myself obtained an ice lens by causing ice to be turned in a lathe to a spherical surface by means of a templet of iron. Through this lens the rays of the sun streamed in abundance, and were concentrated in its focus with such intensity as to burn the hand and instantly set fire to a match. There can be no doubt, therefore, that the rays of the sun, which in those Alpine regions are of such remarkable intensity, find their way into the depths of the glacier. They are a *power*, and there is no such thing as the loss of power. The mechanical "work" which is their equivalent, and into which they are converted when received into the substance of a solid body, accumulates and stores itself up in the ice under the form of what we call elastic force, or tendency to dilate, until it becomes sufficient to produce actual dilatation of the ice in the direction in which the resistance is weakest, and by its withdrawal to produce contraction. How much heat entering the surface of a glacier is necessary to this result has been made the subject of calculation. Supposing the depth of the ice to

\* *Pogg. Ann.*, vol. cxxii., p. 497.

† Read "flame-temperatures."

‡ *Leçons sur la Dissociation*, p. 281.

|| *Pogg. Ann.*, vol. cxxii., p. 161.

\* Read before the Royal Institution of Great Britain, May 13, 1870.



be the same as that at the Tacul, its motion at different depths that which Tyndall found it to be there, and its surface motion that which he measured lower on the Mer de Glace at Les Ponts, and supposing the resistance to shearing of ice to be 75 lbs. per square inch; then the mechanical work, which acting within the mass is necessary to put the glacier in motion, as it actually moves, is  $61\frac{3}{4}$  units of work per square inch of the surface of the glacier per day.\* Now this quantity of work would be supplied by 0.0635 heat-unit entering the ice per square inch of surface per day and diffusing itself through it, each heat-unit being the heat necessary to raise 1 lb. water by  $1^{\circ}$  F. Far more than this heat probably passes the surface and enters into the ice of a glacier on days such as that when the motion was observed which serves as the basis of these calculations.

But *how* does this mechanical power, which thus streams continually into a glacier when the sun shines on it, compel its descent?

The fact of the descent of a sheet of lead when placed upon the inclined surface of a roof, however low the pitch, especially in summer, has long been known; I myself first observed it on the southern side of the roof of the Choir of the Bristol Cathedral, in 1855. I have verified it by the following experiment:—I fixed a deal board 9 feet long and 5 inches broad to the southern wall of my house, so as to form an inclined plane, and upon it I placed a sheet of lead, turning its edges down over the side edges of the board, and taking care that it should not bind upon them, but be free to move with no other obstruction than that which arose from its friction. The inclination of the board was  $18^{\circ}32'$ , the thickness of the lead  $\frac{1}{4}$ th of an inch, its length 9 feet, and its weight 28 lbs. The lower end of the board was brought opposite to a window, and a vernier was constructed, which could be read from within, and by which the position of the lead upon the board could be observed to the 100th of an inch. I began to measure the descent of the lead on the 16th of February, 1858, and recorded it every morning between seven and eight o'clock, and every evening between six and seven o'clock, until the 28th of June. I have preserved all these observations. In the night, between sunset and sunrise, the lead scarcely descended at all. It was on days when the thermometer in the sun varied its height rapidly and much—as on bright days with cold winds, or when clouds were driven over the sun—that the descent was greatest. So remarkable, indeed, was this the case, that every cloud which shut off the sun for a time from the lead, and every gust of wind which blew upon it in the sunshine, seemed to bring it down a step. On such days it would descend from  $\frac{1}{4}$  to  $\frac{1}{2}$  an inch. On the contrary, when the sky was open and clear, and the heat advanced and receded uniformly, the descent was less, although the difference of the extreme temperatures of day and night might be greater. It was least of all on days of continuous rain. The sun was the obvious cause of the descent of the lead. It was master of the lead, as it is of the glacier. A dilatation and contraction of it was caused by the passage into it, and the withdrawal, of the sun's radiant heat, and this dilatation and contraction of the lead caused it to descend. Why it should do so may be easily explained.

Let  $AB$ , Fig. 1, be an elementary plate of the solid, and conceive it to be divided into an infinite number of equal elements by planes perpendicular to its length. Let  $x$  be a point so taken in it that, if it were divided in  $x$ , the thrust necessary to push the part  $xA$  up the plane would equal that necessary to push  $xB$  down it. Let an element at  $x$  be imagined to have its temperature so raised as just to equal this thrust; and let the temperatures of all the elements in  $xA$ , beginning at  $x$ , be equally raised in succession. Each will thus be dilated more than the one before it, because its dilatation will be opposed by a less resistance; and the displacement,  $AA_1$ ,

of the extremity upwards will equal the sum of these several dilatations. In like manner, if the same temperature be added to the elements of  $xB$  in succession, beginning from  $x$ , each will be dilated more than the one before it, and the displacement,  $BB_1$ , of the extremity  $B$  downwards will equal the sum of these several dilatations. The point  $x$  will obviously be nearer to  $A$  than to  $B$ , because the same thrust of dilatation of the element at  $x$  would not be able to push so great a length of the bar up the plane as it would down it.

In this state of the temperature of the plate, let a point,  $x_1$ , be taken such that, if it were divided there, the strain necessary to pull the part  $x_1A_1$  down the plane would just equal that necessary to pull  $x_1B_1$  up it. Let the temperature of the element at  $x_1$  be so diminished as by its contraction just to produce this strain, and let the temperatures of all the elements from  $x_1A_1$  in succession be similarly reduced. Each will contract more than the one before it, because a less resistance will be offered to its contraction; and the displacement  $A_1A_2$  of  $A_1$  down the plane will equal the sum of these separate contractions. In the same way the displacement  $B_1B_2$  of  $B_1$  up the plane will equal the sum of the separate contractions of the elements of  $x_1B_1$ . The point  $x_1$  will be farther from  $A_1$  than  $B_1$ , because the same strain of contraction of an element at  $x_1$  would pull a greater length of the bar down the plane than up it.

It is by the dilatation of the greater length of the plate  $xB$  favoured by its weight that the extremity  $B$  is

FIG. 1.



displaced down the plane when the temperature is raised; whilst it is by the contraction of the less length,  $x_1B_1$ , against its weight that it is displaced up the plane when the temperature is lowered. The extremity  $B$  is, therefore, more displaced down the plane by a given raising of the temperature than it is displaced up it by a corresponding lowering. On the whole, therefore, the extremity  $B$  is made to *descend* the plane to  $B_2$  by a given alternation of temperature. It is by the dilatation of the less length,  $xA$ , that the extremity  $A$  is displaced up the plane, and by the contraction of the greater length,  $x_1A_1$ , that it is displaced down the plane. It is, therefore, less displaced up by dilatation, than it is down by contraction, and on the whole it descends to  $A_2$  by a given alternation of temperature. Both the extremities  $A$  and  $B$  of the plate are, therefore, made to descend when it is subjected to a given elevation and then to a corresponding depression of its temperature; that is, the *whole* plate is made to *descend* from  $AB$  to  $A_2B_2$ .

Now, the theory of the descent of glaciers, which I have ventured to propose, is that they descend, as the lead in this experiment does, by reason of the passage into them and the withdrawal of the sun's rays, and that the dilatation and contraction of the ice so produced is the proximate cause.

There is no substance the dilatation or contraction of which, by changes of temperature, is more thoroughly and accurately known than that of ice. Experiments were made upon it by three independent observers, at the observatory of Pultowa, in the winters of 1845 and 1846, between the temperatures of  $0.9^{\circ}$  R. and  $28.82^{\circ}$  R., from which it resulted that ice is by far the most dilatible of all known solid substances, being nearly twice as dilatible as lead. These experiments have been described by Baron W. Struve, in the "*Transactions of the Academy of St Petersburg*."

The ice of a glacier behaves itself in its descent exactly as the lead did in my experiment.

\* *Proceedings of the Royal Society*, January, 1869, p. 207.



It has been argued in opposition to this theory that the temperature of the ice of glaciers is, by the observations of Agassiz, but very little below  $32^{\circ}$ , and that if radiant heat found its way into it, it would not expand, but melt it. To this there is the obvious answer that radiant heat does find its way into ice as a matter of common observation, and that it does not melt it, except at its surface, and therefore that it *does* dilate it. Blocks of ice may be seen in the windows of ice shops with the sun shining full upon them, and melting nowhere but on their surfaces. And the experiment of the ice-lens shows that heat may stream through ice in abundance—of which a portion is necessarily stopped in the passage—without melting it, except on its surface. My theory supposes that the ice beneath the surface of a glacier is a *solid*. That is all.

Being a solid, and receiving into its substance heat—that work—in great quantities, that work (by the principle of the conservation of force) cannot but be stored up in it, under the form of “potential energy,” and wherever it is present, produce a tendency to dilatation. When that tendency takes effect, it is in the direction of the least resistance to the dilatation of that part. It matters not whether the temperature of the ice be below  $32^{\circ}$  or above it, provided only that the condition of solidity be satisfied. Being a solid, it cannot but dilate and contract under the variations of temperature to which it is subjected; and dilating and contracting, it cannot but descend. To show that the ice of a glacier does not dilate when heat is received into it, it would be necessary to show it not to be subject in this respect to a law common to all other solid bodies.

Great alternations of temperature are not necessary to cause the motion of a glacier. A succession of *small* alternations produces the same effect as one great one. Their effect is cumulative. Alternations backwards and forwards, of  $2^{\circ}$  each, six times repeated, would carry the glacier (under certain assumed conditions) as far down as a single alternation of  $12^{\circ}$ .

The observations of Agassiz on the temperature of the ice of the Aar glacier in 1841-1842, were made in borings from 15 to 200 feet deep. Thermometers placed in these borings never fell below  $0.3^{\circ}$  C., although the external temperature descended at night to  $5^{\circ}$  or  $6^{\circ}$  C. Commonly they showed exactly zero.\* Nothing can, however, be concluded from these experiments, because the thermometers were not *frozen into the ice* of the glacier, or the mouths of the borings so effectually stopped as to prevent the access of air or the percolation of water from the disintegrated ice near the surface. The maintenance of a constant state of humidity in the air of the boring not being thus provided against, the included thermometer could not but remain at zero, however low might be the temperature of the surrounding ice. For the water of the contained air freezing on the sides of the boring (like hoar frost) would raise the temperature around the bulb, by the latent heat set free in freezing, to zero, C. And the humidity of the air being continually renewed, this process would always go on.

“A thermometer is, in short, incapable of taking the temperature of ice, unless that ice be dry.”† These are the words of that eminent man Principal Forbes in the last (I think) of his papers on the subject of glaciers.

On a Friday evening like *this*, eight years ago, another eminent man, whose loss to science we all deplore, addressed the audience then assembled here on the subject on which I have now been addressing you. He possessed every accomplishment for the investigation of it, and had studied it long and successfully; he was versed in physics, and was an able and original mathematician. I speak of Mr. William Hopkins, whose name will always be held in honour by reason of his many contributions to the science of glaciers, and especially because of the explanation he first gave of the formation of crevasses. In the introductory part of the discourse which Mr. Hopkins

then delivered he “insisted on the necessity of a more exact definition of terms and more accurate modes of mathematical reasoning than those which had up to that time characterised the discussion of glacial phenomena.”

That, on the necessity of which he insisted and for which he laboured, I also have laboured for. I have sought to bring the discussion of glacial phenomena out of the wide region of scientific opinion, and place it in that of exact science. That work is, however, still far from being completed. Life, too, is short, and the power to pursue studies such as these is sometimes shorter in duration than life itself. But other workers are behind.

## PROCEEDINGS OF SOCIETIES.

### CHEMICAL SOCIETY.

Thursday, June 16th, 1870.

Professor WILLIAMSON, F.R.S., President, in the Chair.

THE following gentlemen were elected Fellows:—L. A. Lucas and A. W. Bickerton.

Mr. JAMES BELL read a paper “*On Fermentation*.”

A series of experiments has been instituted, and is still in progress, to determine the forms of natural ferment which albumen, derived from different sources and under various conditions, will give rise to.

Albumen of egg was introduced into a cane-sugar solution, and the mixture allowed to ferment at a temperature of  $75^{\circ}$  F. Fungoid cells, different from those of yeast, were formed, and possessed of very little fermentative power, inasmuch as only 0.2 per cent of alcohol were produced in this sample.

Albumen of flour and malt, in a cane-sugar solution, gave rise to the development of a fungoid mycelium, and consequent production of cells and spores similar to those obtained by albumen of egg. These, too, were of very limited fermentative power. The albumen in this case was prepared by coagulation, and then by precipitation. When albumen of the first kind was brought into the sugar solution, the liquid very soon contained parasites, and became rapidly acid. If albumen obtained by precipitation with alcohol was employed, the solution, even after a week, was free from parasites, and also of acidity.

Cold water extracts of flour and malt were added to cane-sugar solution, which also contained some glucose. The extract, on addition of cane-sugar, was converted into mucilage; and the change is permanent in flour-extracts, but extracts of barley-meal possess great power to produce the yeast-cells, which act upon the mucilage, and resolve a portion of it into alcohol and carbonic acid. The development of the yeast-cells in the mucilage is a most interesting sight: the cells, as they multiply, are prevented from separating, on account of the thickness of the solution, and thus remain clustered together.

Cold water extracts of grain abound with microscopic parasites, which soon set up a strong action, thereby giving rise to the production of acid, and doubtless, also, to the transformation of the cane-sugar into mucilage. Boiling destroys these parasites, prevents in a great measure the production of acid, and subsequently yields more alcohol. This conclusion was arrived at after many and varied experiments.

When “pus” was employed as ferment, a fungoid organism, similar to that obtained by albumen from flour and malt, was developed in the solution, which likewise possessed very little fermentative power.

The fermentative properties of two moulds, the blue mould from moist malt and the mould from lemon-juice, were next investigated in a glucose solution. Both proved good ferments.

\* *Bulletin de Genève*, tom. 44, p. 349.

† *Forbes, Phil. Mag.*, March, 1859.



In order to compare the relative fermentative power of the yeast-plants of malt and the grape, the following experiments were instituted:—

To a solution capable of giving 16 per cent alcohol, brewers' pressed yeast was added successively. The limit was reached on the sixteenth day; but the experiment was carried on for upwards of thirty days, when the alcohol in the liquid amounted to 15.91 per cent. When the extreme point was reached, the yeast-cells became contracted and shrivelled; but, when they were transferred to a fresh sugar-solution, they recovered their vitality. In several cases, glucose was added to the cane-sugar solution; and it was here observed that, in the presence of an excess of glucose, comparatively less alcohol was obtained: the alcohol and glucose combined seem to act as an antiseptic.

To the must from English hot-house grapes a known quantity of glucose was added, and the liquid, together with the greater part of the husks, was left to ferment at 65° F. The fermentation ceased in about twenty-three days. Another sample was permitted to ferment at 75° F.; and here all action ceased on the sixteenth day. To a third sample such amount of glucose was added as to bring the glucose naturally existing in the juice up to 40 per cent. In this case, the beginning of the fermentation was delayed much beyond the usual time; and the quantity of alcohol obtained was less than in a case where less glucose had been added.

In all cases the wine-ferment proved to be of greater fermentative power than the malt-ferment.

From all these experiments Mr. Bell deduces the conclusion that it would be advantageous to add to grape-juice some glucose, so as to assist the exhaustion of the must of its fermentative element, and to impart thus to the wine a greater keeping-power. In some instances the fermentation was started in the grape-juice by brewers' yeast: the amount of alcohol here obtained was less than in the cases where the action was caused by the natural ferment of the grape-juice.

Finally, Mr. Bell instituted some experiments to ascertain the influence of change of soil; and the results in connection with the observations made in some of the above experiments lead to the inference that the various ferments have their favourite soils.

The PRESIDENT, in asking the Fellows to vote their thanks to the author, gave a brief *resumé* of the state of knowledge we at the present day possess of the yeast-plant. Though called a "plant," the yeast organism appears in all its functions rather animal than vegetable. The products of its secretion are less complicated than those it takes in. It does not, like plants, require light for its vital process; neither does it absorb heat, but, on the contrary, gives such off. Prof. Williamson then, alluding to Leibig's recent memoir, observed that this distinguished chemist has entirely dropped his ancient notions regarding fermentation, though he somewhat successfully criticised some of Pasteur's statements.

The next paper read was, "*On Organic Matter in Water*," by Dr. HEISCH.

The author was, some time ago, called on to assist a large manufacturer of lemonade, who suddenly found it impossible to make lemonade that would keep; after a day or two it became turbid, and its odour anything but agreeable. On examining the liquid under the microscope, it was found full of small spherical cells, with, in most cases, a very bright nucleus.

After investigating all the materials employed, the water was detected to bear the fault. On putting a few grains of the purest crystalline sugar into some of the water, it became turbid in a few hours, and contained the cells previously described.

On enquiry, Dr. Heisch found that some digging had been going on in the neighbourhood of the well from which the water came; and that, through this circumstance, some drainage must have got into the well. This led the experimenter to try various samples of waters in

the same manner; and, in every case where diarrhœa or other mischief could be traced to the use of a certain water, when that water was treated with sugar, the same cells made their appearance usually within 24 hours, if kept at 60° to 70°, and plenty of light was admitted to the bottle containing the fermenting liquid.

Believing sewage to be the source of these cellular germs, Dr. Heisch mixed a minute quantity of sewage with a sugar-solution which had been previously ascertained to be free of cells, and found the solution very soon to contain those germs. A number of experiments were made to find out whether other substances than sewage or sewage-water were capable of producing organisms of similar kind when placed into a sugar-solution; but, though in a few cases some growths were produced, they never resembled the cells originated by sewage. In all the experiments with sewage, where the particular cells made their appearance, a butyric odour also was perceptible. Filtering the water through the finest Swedish paper does not remove the germs. Boiling for half an hour in no way destroys their vitality. Filtration through a good bed of animal charcoal seems to be the only effectual mode of removing them; but it is necessary to air the charcoal from time to time, else it loses its purifying power.

The author is at present engaged to ascertain what substances are capable of retarding or preventing the development of these germs. As to the conclusions derived from the above observations, Dr. Heisch thinks that wherever the described germs occur in water they are distinct evidence of sewage-contamination.

Mr. PERKIN read a letter from Prof. Strecker, wherein he claims the priority of having published the true formula of alizarine as early as 1866, a priority which had been ignored by Mr. Perkin in his recent lecture on alizarine. Mr. Perkin said that this omission is due only to a slight oversight; he never intended to deprive Prof. Strecker of his merits.

Mr. W. D. HERMAN communicated a paper "*On the Methods for the Determination of Carbon in Steel*."

The author, whilst studying the process for determining carbon in steel known as Eggertz's Colorimetric Method, observed certain irregularities and imperfections in its practical working. One of the most serious difficulties in this process, arising from the instability of the standard solution of burnt sugar, had been overcome for some time past by Mr. Valentin, who employed, with perfect success, a solution of sulphindigotic acid which had undergone decomposition by exposure to sunlight. Although much was gained by substituting a stable for an unstable solution, it was still apparent that the colour of the solution of various samples of steel in nitric acid, especially of those containing larger quantities of carbon, did not always coincide in tint with the new colour-standard.

These difficulties led the author to corroborate the colorimetric results by other methods of analysis. He first tried Elliott's method (described in the new edition of Fresenius's "Quantitative Analysis"); but the washing of the carbon on the asbestos filter was found to be too tedious, and the whole process requiring great care and constant attention. A direct method of analysis was therefore tried, and the iron burnt in a stream of oxygen. The heat produced by this process was, however, so great that the best glass tubes cracked on cooling. This obstacle was surmounted by using a platinum tube, which is connected with the glass apparatus containing the soda-lime, &c., by means of a brass tube tinned inside, and the latter is joined to the platinum tube by means of a bayonet-joint. The steel to be analysed is previously softened, and then reduced to fine filings, by means of a *single-cut* file, which has the advantage of bringing to a minimum the danger of breaking off the teeth, and also of producing filings in fine shreds, a condition very favourable to rapid and complete oxidation. The time required for the oxidation of about 2 grms. of steel was usually forty minutes. The amount of ferric oxide left



behind after the combustion of the carbon may be weighed, and its weight, coinciding with the amount required by theory, serves then as a criterion of the completeness of the combustion.

The following table contains a *resumé* of the means of the results obtained by the different methods employed by Mr. Herman for determining the carbon in various samples of steel:—

	I.	II.	III.	IV.	V.	VI.	VII.	VIII.
By Eggertz's colorimetric method .. ..	1.3190	0.7890	0.7010	0.5870	0.4860	0.3490	0.2830	—
By direct combustion of filings in oxygen .. ..	1.1656	0.7602	0.6350	—	—	0.3594	0.2730	0.9215
By Elliott's methods ..	1.2480	0.8065	0.7240	0.6701	0.5025	0.4772	0.3490	0.9427

From all the foregoing observations it follows:—

1. That Eggertz's process cannot be employed when the amount of carbon is large, and is required to be known with accuracy.

2. That the method of combustion in oxygen is preferable as being direct, expeditious, giving accurate results, and allowing to ascertain readily whether the combustion has been a complete one.

In conclusion, the author expressed his thanks to Mr. Valentin for the valuable advice received whilst conducting these experiments.

#### ROYAL IRISH ACADEMY.

At a meeting held on Monday, June 13th, at the Academy House, the Rev. Prof. JELLETT in the chair, Dr. SIGERSON read a paper on the "*Microscopic Appearances obtained from Special Atmospheres*."

His lecture was illustrated with large diagrams representing some of the objects discovered. In "iron-factory air" he found carbon, ash, and iron: the iron was discovered to be hollow balls, averaging 1-2000th part of an inch in diameter, their shells being only 1-30,000th part of an inch; and the iron was found to be translucent. In "shirt-factory air" there were filaments and fragments of linen and cotton, with minute eggs. The air of threshing and oat mills had fibres, fragments, starch-grains, and spores. "Scutch-mills," from the character and the spongy, spiky dust and its effects, he declared to be human slaughter-houses: by a suggested alteration, the workers could be kept free of the dust, and many lives saved. In the air of the printing-offices antimony was expected, and Dr. Sullivan's analysis confirmed the expectation: it is probably present to an injurious extent in type-foundries. Stable air was shown to contain cuticle-scales and hair; and hairdressers' establishments had a similar atmosphere. Some appalling revelations of the contents of dissecting-room air were made. Smoke being microscopically examined, the tobacco-smoker's air was shown to contain globules of nicotine, a poison. The air inhaled by tea-tasters was discovered to contain tea, sprinkled with fibres, tissue, and drops of a powerful narcotic oil.

He concluded by stating his conclusions arrived at with regard to lung-functions and contagion.

## CORRESPONDENCE.

### TETRABROMIDE OF CARBON.

*To the Editor of the Chemical News.*

SIR,—I am very sorry to trespass again upon your valuable space, but a letter from "The Reporter" in the CHEMICAL NEWS (vol. xxi., p. 273), seems to call for some remark.

In our paper communicated to the Chemical Society on May 5th, the following passage occurs "The bromination

of the bisulphide may, however, be effected by two different methods: by submitting it to the action of bromine in the presence either of bromide of iodine or of antimony terbromide." Any chemist can perceive the great difference between this and the official Reporter's account published in the CHEMICAL NEWS (vol. xxi., p. 223).—I am, &c.,

CHARLES E. GROVES.

17, Rodney Street, Pentonville.

[The report should have read:—"This combination is obtained—1. by heating bisulphide of carbon with bromine and bromide of iodine &c." The omission of the word "bromine" was an oversight.—*Ed. C.N.*]

### LIEBIG'S EXTRACT—BOILING WATER.

*To the Editor of the Chemical News.*

SIR,—I forward some observations on Liebig's extract, derived from my own experience on a walking journey; also the results of my experiments on boiling water with the minimum of fuel.—I am, &c.,

W. T. SUFFOLK.

I became acquainted with Liebig's extract of meat during an illness last summer, when it was prescribed as an article of diet. I had been suffering from indigestion, and could not help noticing the ease with which it was assimilated and its speedy restorative action. Having experienced so great benefit from its use, I resolved to give it a trial during a long pedestrian excursion, and endeavour to test its value as food.

The action of the extract is very marked when used as a remedy for the exhaustion so frequently attending long and fatiguing walks, closely resembling in its effect the well-known restorative, tea and brandy, but it is much more permanent, acting not only as a stimulant, but also as nutritive matter.

The extract cannot well be used by itself as a substitute for ordinary food, but when accompanied by a quantity of less nutritious and digestible matter greatly augments its dietetic value. With Liebig's extract, bread or biscuit, and, if possible, hard-boiled eggs, the pedestrian will be provided for nearly every emergency. For the sake of variety of flavour, pepper, salt, curry powder, or other condiments may be used.

I prefer, when possible, to use the extract in the usual way—dissolved in hot water as soup,—but where hot water cannot be procured, it may be thinly spread upon bread or biscuit and eaten with equal effect. In either way it gives strength almost immediately, and stands very much in the same relation to ordinary food that petroleum does to coal as a steam-producing fuel, enabling power to be speedily obtained.

It must, however, be borne in mind that stimulating food can only be employed as an auxiliary, and not as a substitute for proper rest, the only true restorative. In long pedestrian journeys everything depends upon intervals of rest and proper food, if the exertion is to be continued for many days in succession.

Spirit of any kind should always be used cautiously; as its stimulating power is at the best of short duration nothing is added to actual bodily strength. It is sometimes of value in cases of difficult breathing, caused by steep ascents, a teaspoonful of strong brandy or whisky generally giving instant relief; also in the nervous giddiness which occasionally affects travellers, especially solitary ones, when walking on narrow elevated paths. This may seem somewhat like acquiring "Dutch courage," but nevertheless the discreet use of spirit in such cases is not to be undervalued.

For the purpose of boiling water *en route*, I employ an "Etna" of French construction, made of very thin copper, electro-plated, and weighing, with a store of 6 ozs. of spirit, 1½ lbs.

The time occupied in boiling half a pint of water is



from seven to ten minutes, and the consumption of spirit about two fluid drachms. The apparatus requires a perfectly calm atmosphere for its proper action; this may be secured by building a small cromlech of flat stones, which are always at hand in hilly countries, and with the help of a large handkerchief as a further protection against the wind, no difficulty will be found in securing efficient performance; other contrivances will suggest themselves where stones are not procurable.

Although it would seem that alcohol is consumed to a disadvantage without a wick, yet practically the "Etna" boils water with a smaller consumption of spirit than any contrivance I have yet tried. My best lamp, an argand, requiring at least half an ounce to do the same work as the Etna. The Russian blast lamp is still more wasteful, consuming nearly 2 ounces.

I attribute the superior economy of the Etna to the low temperature of the wickless flame and the manner in which the boiler is wrapped in the fire, no more heat being supplied than can be taken up by so bad a conductor as water. The defect of all lamps giving an intense flame being that heat is wasted by being supplied too quickly, so that the apparently feeble fire in the gutter of the Etna is more efficient than the heat of powerful lamps, as well as more economical; the latter quality is very important to the pedestrian, to whom every ounce of weight is a consideration.

## OZONE AND SULPHUROUS ACID.

To the Editor of the Chemical News.

SIR,—I am not aware that the resemblance between these substances has been noticed, though, that  $O_3$  and  $SO_2$  are molecules containing the same number of like atoms similarly condensed, must be readily apparent, as also that the series



might be continued to include  $OO_2$ , just as naturally as the series

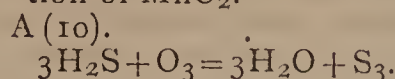


includes as its last term  $OH_2$ .

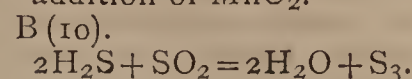
That the argument may not, however, rest solely upon considerations of atoms, volumes, and family analogies, which might be deemed by some persons fanciful and inconclusive, I rapidly parallel a few physical or chemical correspondences:—

$OO_2$ .	$SO_2$ .
A (1). Odorous, dense, colourless gas.	B (1). Pungent, dense, colourless gas.
A (2). Bleaches, disinfects, deodorises.	B (2). Bleaches, disinfects, deodorises.
A (3). Tarnishes moist metals, <i>e.g.</i> , Fe.	B (3). Corrodes moist metals, <i>e.g.</i> , Fe.
A (4). Absorbed totally by turps.	B (4). Absorbed partially by turps.
A (5). Whitens lead-paper previously blackened by $H_2S$ .	B (5). Whitens lead-paper previously blackened by $H_2S$ .
A (6). Absorbed by solution of KI, rendering latter yellow by disengagement of free I.	B (6). Absorbed by solution of KI, rendering latter yellow.
A (7). Antozone (its complementary molecule), according to M. Soret, moderately soluble in water, $O_3 + 3H_2O = 3H_2O_2$ yielding a liquid (oxygenated water) partaking properties of gas $O_3$ .	B (7). Very soluble in water, $SO_2 + H_2O = H_2SO_3$ yielding a liquid partaking properties of gas $SO_2$ .
A (8). Solution reduces Ag from its ammonio-nitrate.	B (8). Solution reduces Ag from its nitrate on heating.

A (9). Equilibrium of molecule, very unstable, *e.g.*,  $H_2O_2$  converted to  $2H_2O$  by nascent H, on one hand, and to  $H_2O + O_2$  by addition of  $MnO_2$ .



B (9). Equilibrium of molecule somewhat unstable, *e.g.*,  $SO_2$  converted to  $H_2S$  by nascent H, on one hand, and to  $H_2SO_4$  on other by addition of  $MnO_2$ .



These are almost as many concurrences as could be expected in the first two members of any homogeneous series, and are more striking than those of  $H_2S$  and  $H_2O$ , the first two terms of the series before quoted by way of comparison.

But to the whole of these observations I anticipate the objection, "Impossible!  $SO_2$  is universally recognised as a reducer,  $O_3$  as an oxidiser. You assimilate things of diametrically opposite tendencies, *e.g.*,  $O_3$  blues iodised starch paper,  $SO_2$  removes the blue."

To this, if the above instances of chemical resemblances be not sufficient answer, I ask, in reply, "Who shall, after Brodie's experiments on the peroxides, say what is an oxidiser? Why, oxygenated-water itself reduces  $MnO_2$  and  $AgO$ ! Why, in 10 (B),  $SO_2$  is an oxidiser, not a reducer!"

Suffer me, then, to surmise that possibly the advance of chemical discovery respecting the allotropic conditions of oxygen may hereafter confirm that ozone belongs to the  $SO_2$  type. This once admitted many other and important deductions must follow.

B. W. GIBSON, B.Sc.

Eaton Square, June 18, 1870.

## MISCELLANEOUS.

New Work on Quantitative Analysis.—Professor H. Storer, the talented Professor of Chemistry at the Institute of Technology, Massachusetts, is engaged on a work on Quantitative Analysis, the first part of which will be ready in August. It is arranged in dictionary form, and will be one of the most complete and valuable works extant on analysis. The first sheet, which is now before us, treats of the Quantitative Estimation of Acetic Acid, Acetate of Aluminium, Acetate of Barium, Acetate of Iron, Acetate of Lead, Acetate of Sodium (or of Potassium), Acetate of Uranium, Aconitin, Albumin, Alcohol, together with Acidimetry and Alcoholometry. If all the subjects are treated as fully as those in the first sheet, as we have no doubt they will be, the work will be welcomed by all chemists.

British Association for the Advancement of Science (Fortieth Meeting).—The Liverpool Meeting of the British Association for the Advancement of Science will commence on Wednesday, September 14th, under the presidency of Professor Huxley, F.R.S., F.G.S., &c. The facilities for communication with Scotland, Ireland, and America, as well as all parts of England, render it probable that this meeting will be very numerously attended; and it is the earnest wish of the local authorities, the representatives of the various scientific bodies, as well as of all those officially connected with the Association, that the members and associates should receive a cordial welcome, and that everything possible should be done to make the visit agreeable and instructive. Liverpool enjoys special advantages in its power of affording the various sections suitable accommodation within a limited area. There is much connected with the trade of Liverpool which cannot fail to be interesting to strangers. The river Mersey, with its line of docks, five miles in length; the great works at Birkenhead; the large warehouses, fitted with the latest mechanical appliances; the quay sides, covered with the various produce of all climes; and the numerous charitable institutions on the river, offer a class of attractions almost peculiar to Liverpool;—while



its shipbuilding yards, foundries, chemical, and various other works on an extensive scale, and its vicinity to the mining and manufacturing districts, enable it to meet the tastes of all classes of scientific men. The proximity of Chester and the coast of North Wales places many interesting spots within easy reach, and excursions will be planned, affording the members and associates an opportunity of visiting such as they may select. Arrangements have been made with the Railway, Ocean, and Coasting Steam Ship Companies for the conveyance of members to and from Liverpool at a reduced rate. The proprietors of the principal hotels have submitted a moderate tariff of charges, not exceeding their usual terms, and numerous offers of private hospitality have been placed at the disposal of the local officials. There is a foreigners' club, and there are a large number of foreign gentlemen, engaged in business, who will assist in providing for the comfort of those continental visitors who may attend. Those who require information and assistance in the way of providing lodgings, or other accommodation, are requested to communicate with the honorary local secretaries, Messrs. Wm. Banister, R. Harrison, H. H. Higgins, and A. Hume, at the Municipal Offices, Dale Street, Liverpool.

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

*Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

**NOTE.** All degrees of temperature are Centigrade, unless otherwise expressed.

*Comptes Rendus des Séances de l'Académie des Sciences, June 13, 1870.*

Omitting memoirs, papers, and communications relating to other departments of science, this number contains the following original matter on physico-chemical and collateral sciences:—

**Specific Heat of Mixtures of Alcohol and Water.**—Drs. Jamin and Amaury.—The authors, after briefly alluding to a former memoir on this subject, now proceed to give, in a lengthy memoir, a description of a series of experiments based upon the employment of a general algebraic formula, which, in fact, appears to be applicable not only to mixtures of water and alcohol, but also to various other liquids for the purpose of estimating the specific heat of mixtures of the same and of water. The paper is chiefly an algebraico-physical essay.

**Physical Phenomena Observed during the Bursting of Hollow Cast-Iron Projectiles (Bomb-Shells, &c.), brought about by the Freezing of Water.**—Dr. Ch. Martins and G. Chancel.—The authors reply to the observations and remarks made to their first communication on this subject by General Morin and other savants, and point out that the object they had in view while making these experiments, was to learn under what conditions, and with what phenomena, hollow cast-iron vessels (projectiles being most available for such purpose) will burst; moreover, the decrease of bulk of the bomb-shell, brought on by the cold, is only 1.33 c.c., a quantity too small to affect the experiment. The authors agree, however, with the General, that there is a very essential difference between the action of gunpowder and of freezing, although the ultimate effect is the same—viz., bursting of the projectile.

**Cause of the "Rochage" of the Carburets of Iron, and on the Sparks Produced by these Metals.**—H. Caron.—The author understands, by *rochage*, a peculiar production of sparks, best seen when molten cast-iron is run off from the blast furnace into moulds. In this lengthy paper, the author describes a series of experiments undertaken with the view to prove that, since steel and cast-iron, when molten in an atmosphere of hydrogen or oxide of carbon, never emit sparks, the production of the latter cannot be due to an evolution of reducing gas absorbed during the fusion, but is due, according to the author, to the formation of oxide of iron at the moment the molten metal comes in contact with air. When iron is kept fused in an atmosphere of hydrogen, its sp. gr. is increased from 7.84 to 7.88, while the metal becomes as soft and malleable as copper. When cast-iron is kept fused for a long time in a crucible, it absorbs oxygen, becomes lamellar, and, on cooling, contracts so suddenly as often to leave the inside of the mass hollow.

**Mechanical Equivalent of Heat.**—J. Violle.

**Electrolysis of Air, or Oxygen, as a means of Producing Ozone.**—A. Houzeau.—The author of this paper summarises, in thirteen corollaries, all facts relating to, and brought out by, a series of no less than 400 experiments made by him on this subject. The author also states that he has contrived what he calls an *ozoniseur*, a machine to convert, instantaneously, any desired quantity of air or oxygen into ozone.

**Researches on Platinum.**—P. Schützenberger.—The author states that the chloro-platinite of carbonyl,  $\text{COPtCl}_2$ , and the chloro-platinite of dicarbonyl,  $\text{C}_2\text{O}_2\text{PtCl}_2$ , may be viewed as being the chlorides of two diatomic compounds—viz., platoso-carbonyl,  $(\text{COPt})$ , and platoso-dicarbonyl—



And, in order to prove the correctness of this view, describes at length, in this paper, the action of ammonia, of ether, of protochloride of phosphorus, and other reagents, upon the compounds alluded to, and upon the chlorides of platinum.

**Tribromhydrine.**—L. Henry.—The main object of this very exhaustive and lengthy memoir is to prove the absolute identity of tribromhydrine and tribromide of allyl.

**Action of Ammonia upon Lecithine.**—M. Gobley.—By the action of ammonia upon this substance, the author has succeeded in producing neurine, margaramide, and adipoglyceric acid. Samples of these substances were exhibited at this meeting of the Academy.

**Hailstorm near Alais on May 29th last.**—E. Bourgoigne.—In a letter to M. Dumas, the author relates the particulars of a fearful hailstorm which has taken place in and around Alais (Département du Gard) on the above-named day, and which caused an immense destruction of property of various description, utterly destroying all crops, killing lambs, and covering the roads with hail to a depth of 30 centimetres (11.81 English inches). Most of the olive and nut-trees were decorticated, and a very old olive-tree cut off at the roots, and carried to a distance of 30 metres by the violent wind prevailing during the storm, the like of which has never been witnessed there before, being far more violent than that which took place in 1830 in the same locality.

**The Bouma das Morts, near Alais.**—The scientific committee occupied with the investigation of this grotto write to the Academy to say that they have discovered that originally this grotto was a lead mine, worked for the extraction of the ore of that metal, at a so remote period that it is at present difficult to form any opinion thereon; and it appears that, afterwards, the cavity has been either the habitation or the sepulchre of an extinct human race, the remains of which are now being fully explored.

**Lowering the Temperature of Water.**—A. Toselli.—The eminent Permanent Secretary of this Institute, M. Dumas, says—The author asserts that he has succeeded in lowering the temperature of water 13° C., by immersing, in that fluid, a tube spirally wound and turned round its axis. The author gives a complete drawing of that tube, but does not state how the experiment is to be made, nor what means employed to bring about the very desirable cooling, desirable especially during hot summer days.

*The American Journal of Science and Arts, No. 147, May, 1870.*

Omitting the titles, of the original papers and memoirs contained in this number and intended for full publication in our paper, we abstract and quote the following original papers relating to chemistry and collateral sciences:—

**Method of Producing, by the Electric Spark, Figures similar to those of Lichtenberg.**—E. W. Blake, jun.—The author reviews the history of electricity and the production of the figures alluded to, and then states—The method consists in throwing the discharge upon the surface of a fusible non-conducting body. If the body be near its fusing-point, the figure appears at once; if cold, a latent image exists, which may be developed by heat. The non-conducting surface is prepared by coating a plate of metal with an even film of pitch. Pieces of sheet tin, 3 inches square, coated with films of pitch of a thickness varying between 0.01 and 0.02 inch, were used; the pitch was the ordinary article of commerce, freed from sand, &c., by being melted and strained through a muslin bag. Shellac, resin, Burgundy pitch, bees'-wax, and Canada balsam were, in turn, tried as substitutes for pitch, but with unsatisfactory results. The author then describes (illustrating that description by woodcuts) his electric apparatus, and gives cuts, also, of the figures (Lichtenberg) as produced by frictional electricity and the induction coil.

**Magnesium and Electric Lights as applied to Photo-Micrography.**—J. J. Woodward.—A lengthy paper, illustrated by several engravings.

**Mechanical Finger for the Microscope.**—J. H. B. L.—With woodcuts.

**Combinations of Silicon with Alcoholic Radicals.**—C. Friedel and J. M. Crafts.—This lengthy memoir is divided into the following sections:—Silicic ethide; action of bromine on silicic ethide; the oxide of silicic tri-ethide; action of chlorine on silicic ethide; the acetic ether and the alcohol of silicic ethide; oxidation of silicic ethide; silicic methide; silicic ethide and methide.

**Description and Analysis of the Franklin County Meteoric Iron; with Remarks on the Presence of Copper and Nickel in Meteoric Irons, the Method of Analysing the same, and the probability of the Lead in the Tarapaca Iron having been**



originally foreign to that mass.—J. Lawrence Smith.—This rather lengthy paper treats, in its first section, of the Franklin County meteoric iron (sp. gr., 7.692); its weight was 24 lbs. Composition, in 100 parts—Iron, 90.58; nickel, 8.53; cobalt, 0.36; copper, minute quantity; phosphorus, 0.05.

**Examination of a New and Extraordinary Gas-Well in the State of New York.**—H. Wurtz.—This paper is chiefly of local importance; but the following brief scraps have a general bearing. It appears, in the first place, that some four years ago, the owner of a piece of ground in the township of West, Bloomfield County, Ontario, while boring for petroleum, struck, at about 500 feet below the surface, a cavity from which a copious stream of gas commenced blowing off at the rate of 400,000 cubic feet per day. The bore-hole is tubed down, and 5 inches in diameter; and the issuing gas, when burning, gives, in a still atmosphere, a flame 30 feet high. This phenomenon has now continued for fully four years. The gas consists, per centically, of—Marsh gas, 82.41; carbonic acid, 10.11; nitrogen, 4.31; oxygen, 0.23; illuminating hydrocarbons, 2.94;—sp. gr., 0.693.

**Certain Double Sulphates of the Cerium Group.**—C. H. Wing. **New Aspirator.**—J. C. Draper.—Illustrated with a woodcut. The principle is that of the Giffard's injector.

**Action of Sunlight on Sulphurous Acid.**—O. Loew.—The author found that, when aqueous sulphurous acid was exposed in sealed tubes to the action of sunlight, it was gradually reduced to sulphur, but the oxygen was not liberated, another part of the acid having been oxidised by it to sulphuric acid.

**Simple Method of Avoiding Observations of Temperature and Pressure in Gas Analyses, and on the Application of Sprengel's Mercurial Pump in Analysis.**—W. Gibbs.—Illustrated with a series of algebraic formulæ and woodcuts.

**Peculiar form of the Discharge Between the Poles of the Electric Machine.**—A. W. Wright.—With diagrams.

**Movement of the Dome of the Capitol at Washington during the Gale of December 10–12, 1869.**—T. Walter.—Although the contents of this paper do not strictly belong to the subjects usually treated of in our periodical, we cannot refrain noticing the curious effects here recorded. The author had constructed a very sensitive apparatus to test the effect of the expansion of the Dome (an iron structure, 137 feet in diameter and 200 feet high) by the sun's rays; it happened, however, that the wind, and not the sun, made use of the author's preparations, and recorded its vagaries through the agency of the vast mass of the dome. One would think such a mass immovable against any action of wind; but this is not so. The author gives a diagram, proving what a gusty day was capable of effecting in giving motion to the mass. It is a well-known fact that tall chimney stalks and high church steeples, shot-towers, and the like, move about in rough weather, as also, perceptibly, do the high towers of Antwerp and Utrecht, though very massive buildings; but movements in a dome such as that alluded to could hardly have been reasonably expected.

*Zeitschrift für Chemie von Beilstein, No. 9, 1870.*

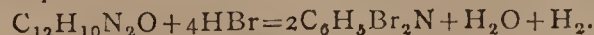
This number contains the following original papers and memoirs:—

**Action of Nitric Acid upon Azotoluide.**—W. Petrieff.—When nitric acid (sp. gr., 1.5) is added to azotoluide, and care taken to cool the mixture, mononitro-azotoluide is formed which is almost entirely soluble in alcohol. On evaporating this solution, two substances are obtained, both composed of  $C_{14}H_{13}(NO_2)N_2$ ; one of these bodies, a red substance, fuses at  $67^\circ$ ; the other, yellow, fuses at  $63^\circ$ . When, however, crystals of azotoluide are added to strong nitric acid, without cooling, two other substances are formed—viz., trinitro-azotoluide, soluble in boiling alcohol, difficultly soluble in ether, fusing at  $185^\circ$ , formula  $C_{14}H_{11}(NO_2)_3N_2$ ; and a body insoluble in alcohol, but soluble in benzol and nitric acid, fusing at  $201^\circ$ , exploding violently when heated to a higher temperature; formula,  $C_{14}H_{11}(NO_2)_3N_2O$ . The author has also tried to obtain these substances by the action of nitric acid upon azobenzid; but this reaction did not lead to the desired results, azoxybenzide being formed. The action of pentachloride of phosphorus is as follows:—



**A Body Homologous with Benzidine.**—W. Petrieff.—Hydrazotoluide is converted, by the cautious addition of sulphuric or chlorhydric acids, into a crystalline body homologous with benzidine, fusing at  $128^\circ$ , and readily soluble in boiling water, alcohol, and ether. This base yields, with sulphuric acid, two different salts, one of which is soluble in boiling water and in alcohol, the other insoluble therein; the formula of the latter is  $C_{14}H_{10}N_2 + 2H_2SO_4$ . The author observes that he obtained this body only from hydrazotoluide, prepared, by means of sodium amalgam, from hydrazotoluide.

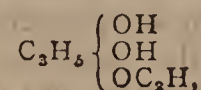
**Action of Hydrobromic Acid upon Azoxybenzide.**—R. Sendzink.—When hydrobromic acid acts upon azoxybenzide, a substance is formed which proved to be bibromaniline—



This reaction, however, only takes place when a large excess of hydrobromic acid is taken; with a small quantity of the latter, an oily substance is obtained, and very little bibromaniline. Hydriodic acid converts azoxybenzide very readily into benzidine.

**Researches on the Allyl Group.**—B. Tollens.—The author, referring, first, to some of his former experiments on this subject, states that allyl-alcohol, obtained by him, does not yield, when treated with substances which give off hydrogen, either propylic or isopropylic alcohol. The preparation of allyl-alcohol from glycerine and oxalic

acid, is rendered difficult, by reason of a small quantity of alkali, almost always present in oxalic acid, and very difficulty removable from it. The author, therefore, adds from  $\frac{1}{2}$  to 1 per cent of hydrochloric acid, whereby this objection is obviated. Sulphuric acid may be used, but excess of either should be avoided, especially since even a slight excess of chlorhydric acid causes, at about  $200^\circ$  (the most suitable temperature for the reaction), the formation of mono-allyline—



a liquid boiling at  $240^\circ$ , but then, also, partly decomposed.

**Some Additional Observations on the Formation of Ozone in a Flame.**—O. Loew.—This paper is written as a reply to some remarks published by Dr. Böttger on the author's observations on this subject, wherein the former chemist says that peroxide of hydrogen and carbonate of ammonia are formed in the manner described by the author (see CHEMICAL NEWS, vol. xxi., p. 107). The author now states that, by using a pair of bellows and a large Bunsen gas burner, he has filled, in a short time, a large room with the peculiar odour due to ozone, while delicate tests failed to detect any peroxide of hydrogen or carbonate of ammonia.

*Revue Hebdomadaire de Chimie, June 2, 1870.*

**Analysis of Three Sorts of Corn cultivated near Saulsaie (Département du Rhône).**—Dr. J. Roussille.—This grain (wheat) had been grown experimentally for the purpose of trying a peculiar kind of soil containing no less than 88.9 per cent of silica insoluble in hydrochloric acid. The sorts of corn are termed *bleu*, *rouge*, and *fern*, and were found to contain, in 100 parts, respectively—Water, 14.2, 14.10, 15.32; organic matters, 84.8, 84.22, 82.78; mineral matter, 1.72, 1.68, 1.9. The yield per hectare of each was, in kilos. of the thrashed-out grain, 2576, 1419, and 1956. The soil alluded to contains 0.060 per cent of phosphoric acid and 2.17 per cent of organic matter.

*Jahrbuch der Kaiserlich-Königlichen Geologischen Reichsanstalt, No. 1, 1870.*

This periodical appears only quarterly, and is, moreover, rarely published with great accuracy as to date of publication, it being an official, not a commercial undertaking.

This number contains the following original papers relating to physico-chemical and collateral sciences:—

**The Town of Oldenburg and its Environs in relation to Water Supply.**—H. Wolf.—The town alluded to is in Hungary. The lengthy memoir deserves special notice as an excellent contribution to economico-geological surveys of this description. The paper is illustrated with maps and engravings.

**Report on the Production and Circulation of the Mineral Fuels, and the Localities where these are Found and Wrought in the Austro-Hungarian Monarchy.**—F. Fötterle.

**The Kainite from Kalusz, in Galicia.**—Karl Ritter von Hauer.—The celebrated author of this lengthy memoir states that the kainite found in large quantity at the locality alluded to contains, on an average, in 100 parts—Sulphuric acid, 20.46; chlorine, 28.01; magnesia, 10.16; potassium, 16.38; sodium, 7.97; calcium and protoxide of iron, a trace; water, 14.36; clay, 3.41. Formula,  $KCl + 2(MgO \cdot SO_3) + 6HO$ . The kainite here alluded to agrees very closely in composition with that found near Stassfurth. The author enters, at great length, into details about the manufacture of salts of potassa from this mineral.

*Revue des Cours Scientifiques de la France et de l'Etranger, June 11, 1870.*

This number does not contain any papers directly relating to chemistry; but it contains a lengthy and very clearly-written paper, illustrated by several woodcuts, on the—

**Use of Steam-Backing in Locomotive Engines.**—M. Le Châtelet.

And a lengthy lecture by the celebrated Heidelberg physiologist, Dr. Helmholtz, on the—

**Physiological Action of Electric Currents of Short Duration in the Interior of Conducting Bodies.**

*Les Mondes, June 9, 1870.*

**The Arènes at Paris.**—Rev. Michon.—A lengthy paper illustrated with several woodcuts, and describing the various objects of scientific and historical interest found in this very ancient building, which, for some centuries, has been covered over by the mould and rubbish of a city of later date.

**Experiments on the Physiological and Therapeutical Properties of Phosphate of Lime.**—Dr. R. Dusart.—The chief point of interest in this paper is that phosphate of lime, in some form or other, is absolutely required for the proper performance of the functions of nutrition, since it causes the albumenoid substances to form cells and tissues. The author speaks of a lacto-phosphate of lime as a therapeutic agent, but does not specify what that substance is; it may be a double salt of lactic and phosphoric acid with lime.

**Distances at which Sound can be Heard.**—Rev. F. Moigno.—The fog-horn established at Foucher can be heard, in calm weather,



at a distance of 28 kilometres; during storms, at a distance of from 9 to 15 kilometres; and with wind blowing in the direction wherein the sound is sent (seaward), 46 kilometres. The cannonade at the battle of Waterloo (June 18, 1815) was heard at Creil (France), 200 kilometres distant therefrom; and the cannonade at the battle of March 30th, 1814 (near Paris), was heard distinctly at Casson, between Lisieux and Caen, at 176 kilometres' distance, in each case as the crow flies.

**Conversion of an Ordinary Electric Machine into a Holtz's Machine.**—Rev. Dr. Laborde.—A lengthy paper wherein the author points out how the desired object can be obtained, temporarily, for the purpose of lecture-room experiments.

Cosmos, June 11, 1870.

**Effects of Cold upon Plants.**—Dr. Zurcher, writing from Toulon, states that on the night from the 3rd to 4th of January last, the thermometer in the public garden of the town alluded to marked  $-8^{\circ}$ , and that a large quantity of snow covered the ground and the trees, among which a number of palm-trees, and even *Chamaerops* and *Jubea*, none of which, though exposed to this low temperature, suffered any damage. From observations made by the author and several other parties, it appears that, as regards the injury done to the plants by great cold, the effects thereof do not depend so much on the degree of cold, as on the calmness of the air (absence of wind) and absence of moisture.

**Means of Detecting the Genuineness of Kirschwasser.**—S. Meunier.—Place, in a test-tube, some powdered guaiacum-wood, and add to it some of the Kirschwasser to be examined. If the latter is really genuine, an indigo-blue colour will forthwith appear, and continue for about an hour; but, if the liquor has been prepared with essential oil of almonds, *Aqua laurocerasi*, or crushed cherry-stones macerated in alcohol, only a yellow tint will be produced. The rationale of this curious phenomenon is not explained, and will be the subject of further investigation. Kirschwasser contains, when genuine, hydrocyanic acid, hydride of benzoyl, and a peculiarly-flavoured essential oil not known in the isolated state.

Moniteur Scientifique, No. 324, June 15, 1870.

This number contains the following original papers and memoirs relating to physico-chemical and collateral sciences:—

**Experiments on the Salts of Manganese.**—Dr. A. Commaille.—The author describes at length the action of acids upon permanganate of potassa, aided, in some instances, by the reducing action of alcohol, ether, and electricity. The author observes, casually, that the salts of the protoxide of manganese are, when perfectly pure, quite colourless. The memoir is divided into the following sections:—Nitric acid and permanganate of potassa; sulphuric, hydrochloric, iodic, arsenious, oxalic, acetic, tartaric, citric, tannic, benzoic, and uric acids, respectively, with permanganate of potassa. The author found that, under the influence of the electric current and chlorhydric acid, hydrogen gas alone is given off from the permanganate; the same is observed, under similar conditions, with oxalic acid.

**Palm Oils of Commerce.**—P. Guyot.—Palm oil is obtained from the fruit of the *Avoira* or *Crocro* palm-tree, growing on the coast, and also in the interior of the Guinea. It yields two kinds of oil—viz., a white-coloured, butter-like substance, extracted from the kernel of the fruit, and chiefly used by the natives as food; the point of fusion of this oil is stated to be rather high. The other kind is extracted from the fibrous sarcocarpon surrounding the fruit; at the prevailing temperature of its native country, this oil is fluid, but in Europe it has the consistency of butter; its colour is yellowish orange, and its smell is very much like that of violet flowers; it is insoluble in cold as well as boiling water, slightly soluble in alcohol, and very soluble in ether. The author gives, in a tabulated form, the results of the action of different reagents upon the oil alluded to, and some of the commercial varieties thereof, as imported from other countries where the oil is obtained either from the same or some other kind of palm-tree. The action of the reagents alluded to (sulphuric and nitric acids, ammonia, chloride of zinc, protochloride of tin, pernitrate of mercury, and liver of sulphur) is not sufficiently characteristic to be specifically quoted here; and this is the less necessary, because, as the author also states, adulteration of these oils would not be practised in the country whence they are exported, and certainly not in Europe, unless it were done in a very wholesale manner, and with the application of very inferior fats. The complete solubility in ether is a sufficient test of purity; the colouring matter is readily destroyed when desired.

**Extraction of Copper from its Ores.**—MM. Tessié du Motay and Co.—The authors propose to apply their oxyhydrogen gas for the purpose of oxidising, from copper ores, the other metals they may contain, after such ores have been previously treated so as to be in the state of metallic silicates, as they call it.

**Application of Phenic Acid for the purposes of Leather and Skin Manufacture.**—E. L. C. Baudet.—The author describes, at great length and very exhaustively, all the operations whereby hides and skins are converted into what is generally called leather, and proposes the use of phenic acid as a preservative against various kinds of injury the raw, as well as the ready-made materials are subjected to, from various causes, both during and after their conversion from hides and skins into saleable commodities.

**Detection of Bone-Cuttings among Rased Hartshorn.**—F. Cyrias.—The author advises to take 2 grms. of the material to be tested, to eliminate, first, the adhering dust by means of a fine sieve; next, to dry it at  $100^{\circ}$ ; and then to boil it for an hour with water, to collect

the insoluble residue on previously-counterpoised filters, to wash well with boiling-hot water, and to weigh after drying. If the loss in weight is below 6 per cent, the conclusion, says the author, may safely be that the sample in question does not contain even a trace of genuine hartshorn; if the loss by weight is above 6 per cent, the number, 6, should be deducted from the quantity found, which should be designated as  $n$ ; and the proportion, supposing 10 per cent loss to have been found, will stand— $8:100=4:x=50$  per cent of genuine hartshorn. Since, however, the use of hartshorn, as well as of such preparations as the once renowned *Decoctum album Sydenhami*, are now altogether forgotten, and superseded by more simple substances, this test has only a scientific interest, as indicating in genuine hartshorn a far larger amount of matter soluble in water than is present in bones.

Bulletin de l'Académie Royale des Sciences, des Lettres et des Beaux Arts de Belgique, No. 3, 1870.

This number contains the following original papers relating to physico-chemical sciences:—

**Meteorite from Saint-Denis-Westrem, near Ghent.**—S. Meunier.—This stone, weighing 720 grms., which fell from the sky on the 7th of June, 1855, the fall being accompanied by a loud detonation and strong emission of light, belongs, according to the author, to what he terms *lucite*, a white-coloured, fine-grained, harshly-feeling very crystalline substance (sp. gr., 3.43) consisting for 88.9 per cent of a lithoid matter, made up of silica, magnesia, oxides of iron, alumina, soda, and potassa, with traces of lime and oxide of chromium. Fully 65 per cent of this quantity is soluble in chlorhydric acid. By means of the magnet, about 8 per cent of metal, chiefly iron, is separated. The paper contains an exhaustive discussion on the origin of meteorites; and the author states that our moon is gradually tending more and more to become broken up into smaller spheroids, some of which may reach our globe as meteoric stones at a future day.

**Discovery of a Layer of Native Phosphate of Lime under the City of Leuven (Louvain), Belgium.**—G. Lambert.—It appears that the municipal government of the city alluded to have, for some purpose or other (not specified), been making borings deep into the soil in a central part of that place. Among the minerals obtained are—At a depth of 110 metres from the surface, a layer of a material containing—water driven off at  $100^{\circ}$ , 1.28 per cent; water driven off at red-heat, after drying at  $100^{\circ}$ , 6.42 per cent; insoluble in chlorhydric acid, 16.42 per cent; anhydrous phosphoric acid, 29.90 per cent. This material contains, therefore, about 62 per cent of tribasic phosphate of lime.

## NOTES AND QUERIES.

**Bromine.**—Can you, or any of your readers, give me a thoroughly-accurate process for the separation of bromine from bromic acid, where the two exist together as a bromide and bromate of an alkali.—J. H. WATSON.

**Phosphate of Ammonia.**—(Reply to "J. W. M.")—You will find, in any of the larger works treating on chemistry, what you require. Consult the excellent work of Dr. W. A. Miller, or Watts's "Dictionary," and the works of the late Dr. Brande, &c., all of which you can inspect at the Library of the Commissioners of Patents.

**Persulphide of Hydrogen.**—I should feel obliged if you can inform me whether the actual composition of persulphide of hydrogen has ever been demonstrated analytically, as I am endeavouring to attain this myself.—W. B. G.

**Method for the Removal of Stains of Iron Mould from Fabrics.** The removal of these stains is a matter of some difficulty if they have remained on a fabric for some time. The usual substances employed for this purpose (oxalic acid or quadroxalate of potassium) require placing, in concentrated solution, in contact with the material for a considerable time, thereby materially weakening and rotting the fibre. The following method is free from this objection, and will remove stains of long standing almost immediately:—Wet the mark with yellow sulphide of ammonium, by which it will be immediately blackened, and allow it a minute or so to penetrate; then wash out the excess of sulphide, and treat the black spot with cold dilute chlorhydric acid, by which it is immediately removed. Finally, wash well with water.—W. B. G.

## TO CORRESPONDENTS.

J. R.—The method given in Fresenius may be relied on.

W. N. (Huddersfield).—There is no objection to the use of hydrochloric acid instead of sulphuric in the preparation of  $\text{CO}_2$ , provided the gas is washed with carbonate of soda solution.

F.C.S.—Your letter has been referred to the reporter.

B. W. Gibsons.—Thanks for your paper; it shall be inserted in an early issue.

James R. Gregory.—We have received your catalogue of minerals, &c.; it seems to be very complete, and the prices being affixed makes it valuable to all mineralogists.

J. Pattison.—A work by the Editor, embracing both the subjects you name, is in the press.

Chrome Colour.—There is a letter for this correspondent at our office.

J. W. M.—Send your address to our publisher.



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